DIRECTORATE-GENERAL FOR MOBILITY & TRANSPORT

Directorate D – Waterborne
Unit D1 - Maritime transport and logistics

Guidance on the FuelEU Maritime Regulation

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Disclaimer

This document is part of a series of documents provided by the Commission services for supporting the implementation of FuelEU Maritime Regulation. The guidance represents the views of the Commission services at the time of publication. It is not legally binding.

The aim of this guidance is to support the implementation of the FuelEU Maritime Regulation, by explaining its requirements in a non-legislative language. For some more specific technical issues, further guidance documents may be made available in the future. Such guidance documents would be accessible through the Commission's website as well.

This guidance document was endorsed in its first version by Member States of the ESSF Subgroup on the Implementation of the Fuel EU Maritime Regulation in its meeting on 8th October 2025.

Version History

Date	Version Status	Remarks
08 October 2025	Published	First version endorsed FEUM MS Implementation group

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List of abbreviations

AFIR	Alternative Fuels Infrastructure Regulation
BDN	Bunker Delivery Note
CCS	Carbon Capture Storage
Cf	(Carbon) Emission Factor
CH4	Methane
CO2	Carbon Dioxide
CSR	Continuous Synopsis Record
DoC	Document of Compliance
EC	European Commission
EEA	European Economic Area
EEDI	Energy Efficiency Design Index
EEXI	Energy Efficiency Existing Ship Index
EMSA	European Maritime Safety Agency
ESSF	European Sustainable Shipping Forum
EU	European Union
EU ETS	EU Emissions Trading Scheme
EU MRV	EU Monitoring, Reporting and Verification
GHG	Greenhouse Gas
GT	Gross Tonnage
HFO	Heavy Fuel Oil
IAPP	International Air Pollution Certificate
IMO	International Maritime Organization
ISCC	International Sustainability and Carbon Certification
ISM	International Management Code for the Safe Operation of Ships and for Pollution Prevention
LBSI	Lean Burn Spark Ignited
MARPOL	International Convention for the Prevention of Pollution from Ships
LCV	Lower Calorific Value
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
MDO	Marine Diesel Oil
MJ	Megajoule
NAB	National Accreditation Body
N2O	Nitrous Oxide
OCT	Overseas Countries and Territories
OPS	Onshore Power Supply
PoC	Proof of Compliance
PoS	Proof of Sustainability
RCF	Recycled Carbon Fuels
RED	Renewable Energy Directive
RFNBO	Renewable Fuels from Non-Biological Origin
Ro-Ro	Roll-on Roll-off
SAPS	Sustainable Alternative Power for Shipping
TEN-T	Trans-European Transport Network
TFEU	Treaty on the Functioning of the European Union
TtW	Tank-to-Wake

UDB	Union Database for Biofuels
WAPS	Wind-Assisted Propulsion System
WtT	Well-to-Tank
WtW	Well-to-Wake
ZET	Zero-Emission Technology

1 Introduction

1.1 About this document

This guidance document aims to support the implementation of the FuelEU Maritime Regulation by explaining its requirements in a non-legislative language. For some more specific technical issues, further guidance documents may be made available in the future. Such guidance documents would be accessible through the Commission's website as well.

This guidance document recognises the significant work done at the European Sustainable Shipping Forum – Sustainable Alternative Power for Shipping (ESSF-SAPS). The valuable input from two Work Stream (WS) reports – developed under ESSF-SAPS – has been incorporated into this guidance document:

- Workstream 1 – FuelEU Calculation Guidance
- Workstream 2 – Greenhouse Gas (GHG)/Sustainability Certification of Marine Bunker Fuels

This document interprets the legislation regarding requirements for shipping companies and indicates which requirements have to be fulfilled by them. As the FuelEU Maritime Regulation is highly intertwined with the EU Monitoring, Reporting and Verification (EU MRV Regulation) and the EU Emission Trading System (EU ETS) Directive, overlaps and differences are mentioned. Where relevant, reference is made to the EU MRV/ETS guidance documents (Guidance document no. 1 – General guidance for shipping companies: the EU ETS and MRV Maritime). In addition, the interrelation of the FuelEU Maritime Regulation with the Renewable Energy Directive (RED) and the Gas and Hydrogen Directive is addressed in this document where appropriate.

This document contains a set of icons. Below, the icons and their meaning are explained in more detail.

Concepts and definitions
The Regulation contains references to technical concepts and requirements. Where relevant, these concepts are defined and further explained.

Comparison with other EU legislation
The FuelEU Maritime Regulation builds further upon the regimes introduced under the EU MRV and EU ETS. The Regulation is also interlinked with RED and the Gas and Hydrogen Directive. Where relevant, interlinkages, differences and/or overlaps are highlighted.

Links to other documents
Besides this document, much other documentation is available. Links to these documents have been included throughout the text.

Examples
Where relevant, examples of the FuelEU Maritime Regulation's applications are given. These examples illustrate the functioning of the Regulation in practice.

Be aware
This icon indicates that the application of the FuelEU Maritime Regulation might deviate from what is included in the legal text or that exemptions are possible. In such cases, some caution is needed.

Where relevant, this document contains hyperlinks to relevant legislation, documents or other materials that help to understand the FuelEU Maritime Regulation and its requirements.

1.2 Where should I start reading?

This guidance document starts with two generic chapters. Chapter 2 describes the rationale behind the FuelEU Maritime Regulation as well as the main actors involved, and Chapter 3 introduces the scope of the Regulation.

Part I provides more details on the requirements for energy used on board. Chapter 4 provides information on the GHG intensity limits and ways to calculate them. Chapter 5 touches upon fuel documentation and certification, while Chapter 6 provides more information on the use of zero-emission requirements at berth.

Part II deals with the administrative obligations stemming from the Regulation. Chapter 7 introduces the different steps in the compliance cycle. Further details on the monitoring plan can be found in Chapter 8. Chapter 9 provides similar guidance for the FuelEU Report. In Chapter 10, the compliance balance is further detailed, while Chapter 11 describes the different flexibility mechanisms in place to ensure compliance. Chapter 12 describes the possible penalties and sanctions introduced under the Regulation.

Part III contains closing remarks. Chapter 13 briefly describes which elements of the Regulation could be changed in the coming years, and Chapter 14 describes which other sources provide further guidance.

The guidance document is accompanied by several **annexes**. Annex I details the steps to determine the Well-to-Wake intensity of fuels, and Annex II provides detailed guidance relevant to the monitoring plan. Annex III provides an overview of all sources used to develop this document.

Where are the different articles of the Regulation covered?
In this document, the requirements and obligations laid down in the Regulation are described in more detail. Table 1.1 provides an overview of the main articles of the Regulation and indicates where more information can be found on them in this document.

Table 1.1 Overview of the FuelEU Maritime Regulation and coverage of its articles in this document

Article	Topic	Covered in
Chapter I – General provisions[1]		
Article 1	Subject matter and objective	Chapter 2
Article 2	Scope	Chapter 3
Chapter II – Requirements for energy used on board by ships		
Article 4	GHG intensity limit on energy used on board by a ship	Chapter 4
Article 5	Use of Renewable Fuels of Non-Biological Origin	Chapter 4
Article 6	Additional zero-emission requirements for energy used at berth	Chapter 6
Chapter III – Common principles and certification		
Article 7	Common principles for monitoring and reporting	Chapter 9
Article 8	Monitoring plan	Chapter 8
Article 9	Modifications to the monitoring plan	Chapter 8
Article 10	Certification on fuels and emission factors	Chapter 5
Chapter IV – Verification and accreditation		
Article 11	Assessment of the monitoring plan and of the modified monitoring plan	Chapters 7 & 8
Article 12	General obligations and principles for the verifiers	Chapters 2 & 9
Article 13	Verification procedures	Chapter 9
Article 14	Accreditations of verifiers	Chapter 2
Chapter V – Recording, verification, reporting, and assessment of compliance[2]		
Article 15	Recording, verification, reporting, and assessment of compliance	Chapters 7 & 9
Article 16	Verification and calculation	Chapter 7, 9 & 10
Article 17	Additional checks by a competent authority	Chapter 2
Article 19	FuelEU database and reporting	Chapter 7
Article 20	Banking and borrowing of compliance surplus between reporting periods	Chapter 11
Article 21	Pooling of compliance	Chapter 11
Article 22	FuelEU document of compliance	Chapters 2, 7 & 11
Article 23	FuelEU penalties	Chapters 2, 7 & 12
Article 24	Obligation to hold a valid FuelEU document of compliance	Chapter 7
Article 25	Enforcement	Chapter 12
Article 26	Right to review	Chapter 10
Article 27	Competent authorities	Chapter 12
Chapter VI – Delegated and implementing powers and final provisions[3]		
Article 30	Reports and reviews	Chapter 3, 4, 5, 6 & 13
Annexes		
Annex I	Methodology for establishing the greenhouse gas intensity of the energy used on board by a ship	Chapters 3, 4, 6, 8 & 10
Annex II	Default emission factors	Chapters 4, 6 & 10
Annex III	General requirements for zero-emission technologies	Chapter 6
Annex IV	Formulas for calculating the compliance balance and Fuel EU penalties laid down in Article 23(3)	Chapters 4, 10, 11 & 12
Annex V	Calculation of adjusted mass of fuel for ice navigation.	Chapter 4

1 Article 3 on definitions is explained where relevant.

2 Article 18 lays down an obligation for the European Commission and as such is not directly relevant for shipping companies.

3 Only Article 30 is presented in this overview as this is the most interesting article for shipping companies. The other articles included in the Chapter are procedural and do not directly impact the functioning of the Regulation.

2 The FuelEU Maritime Regulation in a nutshell

Before diving into detailed descriptions of how the FuelEU Maritime Regulation works, this chapter provides a short summary of the Regulation. This chapter explains why the FuelEU Maritime Regulation was adopted, what it aims to do, and which actors are involved in its execution.

2.1 Background of FuelEU Maritime

The maritime sector is vital to the European Union (EU), driving economic growth through trade and job creation. With extensive coastlines and ports, the EU heavily relies on maritime transportation to facilitate the flow of goods and connect the EU to global markets. However, the shipping sector is also the subject of environmental concerns. Even if shipping is one of the least carbon-intensive modes of transportation (in terms of tonne-kms), it still accounts for 11% of all EU Carbon Dioxide (CO_2) transport emissions, or 3% to 4% of the total EU CO_2 emissions.[4] As the maritime sector continues to grow, reducing emissions has become a pressing priority.

This priority is addressed in the European Green Deal, which can be perceived as the cornerstone for achieving a green maritime sector. The Green Deal is the long-term strategy to achieve climate neutrality by 2050 and cut emissions by 55% by 2030 compared to the 1990s. In the EU economy, maritime transport has a crucial role, and it is one of the most energy-efficient modes of transport; however, it is also a growing source of GHG emissions, which the Green Deal aims to tackle. The Green Deal aims to increase the usage of renewables and sustainable fuels across the maritime sector.

Following the Green Deal, the Commission published the Fit for 55 package, a set of policy proposals to ensure the EU is on track to meet the Green Deal goals. Important policy proposals entail:

- The revision of the EU emissions trading system (EU ETS) to also include emissions from the maritime transport sector. The verification and accreditation rules for the reporting of aggregated emissions data at the shipping company level under Article 3ge of the EU ETS are harmonised with the monitoring requirements set out by the FuelEU Maritime Regulation.

- The adoption of the deployment of alternative fuels infrastructure regulation (AFIR). This Regulation ensures, amongst others, minimum infrastructure to support the required uptake of alternative fuel vehicles across all transport modes and in all EU Member States to meet the EU's climate objectives. Thus, creating a specific target to deploy infrastructure, such as mandatory on-shore power supply (OPS) in ports to ensure enough alternative fuel refuelling points across the EU for ships.

[4] European Commission (2023). Reducing emissions from the shipping sector. Retrieved from: https://climate.ec.europa.eu/eu-action/transport-emissions/reducing-emissions-shipping-sector_en.

- The revision of the Renewable Energy Directive (RED). This Directive sets targets for increased renewable energy use. The binding target for the overall renewable energy target is set at least 42.5% at the EU level by 2030, but aims for 45%. The Directive covers all sectors, including the maritime sector. Important are the inclusion of the renewable fuels of non-biological origin (RFNBO) and the GHG emission savings thresholds included in the Directive.

- The amendment of the Regulation on the monitoring, reporting and verification of greenhouse gas emissions from maritime transport (EU MRV). This Regulation obliges ships to report verified emissions data to the EU THETIS MRV data reporting database. With the amendment of the Regulation (i), general cargo ships below 5000 Gross Tonnage (GT) but not below 400, and (ii) offshore ships of 400 GT and above have been added to the scope.

- The adoption of the FuelEU Maritime Regulation, which will help decarbonise the maritime sector by setting limits on the annual GHG intensity of the energy used by ships. The Regulation applies to all ships above a GT of 5000 that serve the purpose of transporting passengers or cargo for commercial purposes, regardless of their flag. By introducing flag-neutral obligations, the Regulation does not jeopardise the strong international competition in the maritime sector.

The FuelEU Maritime Regulation was adopted on 13 September 2023. The Regulation entered into force on 1 January 2025, except for Articles 7 (monitoring plans) and 8 (modifications to the monitoring plan), which already entered into force from 31 August 2024 onwards.

2.2 Aim of FuelEU Maritime

The Regulation helps to decarbonise the maritime sector by setting limits on the annual GHG intensity of the energy used by ships. **It aims to accelerate the uptake of renewable and low-carbon fuels (RLCF) by introducing limits on GHG intensity for the energy used on board ships and mandating the use of OPS in European Economic Area (EEA) ports.** The Regulation introduces a methodology to calculate the amount of GHG per unit of energy used onboard by a ship as per Annex I and default values in Annex II to this Regulation.

To ensure ships reduce the GHG intensity of the energy used on board, **a system of monitoring, reporting, and verification has been introduced**. For each ship, a monitoring plan needs to be prepared, indicating how the energy used on board will be measured. This plan needs to be verified by an accredited verifier. During each calendar year, the energy used on board a ship needs to be monitored. Once the calendar year is finished, the energy used on board the ships needs to be reported on. The results are included in the FuelEU report. This report is also verified by an accredited verifier. Based on the results, the verifier will calculate whether the ship and an associated compliance balance are in compliance with the GHG limits set by the Regulation. If a ship is non-compliant (i.e. the GHG limits have been exceeded), action needs to be taken to become compliant. The Regulation provides several options to become compliant (such as borrowing, pooling, or paying a penalty). Once a ship is compliant, a Document of Compliance (DoC) is issued.

The Regulation is not a standalone document as it is accompanied by 14 implementing and/or delegating acts, which provide further detail on the application of the Regulation.

The following acts are foreseen:

1. Implementing act on verification activities
2. Delegated act on methods & criteria for the accreditation of verifiers
3. Implementing act on the template for monitoring plans
4. Implementing act on rules for the FuelEU Database
5. Implementing act on the list of neighbouring container transhipment ports
6. Implementing act on communication on OPS
7. Implementing act on the criteria for the acceptance of zero-emission technologies for Annex III
8. Delegated act on the calculation of penalties
9. Delegated act on updating/ amendment of Annex II (default emission factors)
10. Delegated act on supplementing the existing table in Annex III with additional zero-emission technologies.
11. Implementing act on international standards/ certifications to demonstrate actual Tank-to-Wake (TtW) emission factors
12. Delegated act on criteria and method for RFNBOs assessment
13. Delegated act on revising RFNBO sub-target and informing about non-applicability.
14. Implementing act on the specification of rules for the application of the RFNBO sub-target

For an up-to-date overview of the adoption of each of these implementing or delegated acts, please refer to the Commission's website.

2.3 Involved actors and their role

Within the FuelEU Maritime Regulation, several actors play a key role. Each of those actors, as well as their role in fulfilling the requirements of the Regulation, is introduced below. Where relevant, links to further reading have been included.

2.3.1 Companies

The FuelEU Maritime Regulation's **main requirements apply to companies**. A company is defined as the entity that is responsible for the operation of the ship and takes on all the duties and responsibilities imposed by the International Management Code for the Safe Operation of Ships and for Pollution Prevention (ISM Code). **This entity is called the ISM Company**.

It could be the shipowner, but also any other organisation or person tasked with the ship's operation and the ISM Code obligations (Article 3(13)). The ISM Company is specified on the ship certificate.[5]

In a nutshell, the ISM Company is responsible for:

- Drafting and updating the ship monitoring plan
- Monitoring energy used by the ship and associated emission factors

[5] More specifically on '*the Copy of DoC issued in accordance with the International Management Code for the Safe Operation of Ships and for Pollution Prevention.'*

- Reporting on the energy used and associated emission factors in the FuelEU report
- Taking action based on the Compliance Balance
- Paying the penalties in case of a deficit
- Ensuring the ship holds a valid DoC

The ISM company is the company responsible for all requirements under the FuelEU Maritime Regulation. This approach differs from the approach chosen under the EU MRV / EU ETS. In the latter regime, the responsible company is either the ISM company or the registered shipowner.

In terms of data, the company needs to collect and share the following data:

- The ship's permanent characteristics, which are included in the monitoring plan
- The annual fuel consumption
- The annual OPS and Zero-Emission Technology (ZET) energy consumption
- The annual energy exemptions
- Emission factors
- Fuel Bunker Delivery Notes (BDNs)

2.3.2 Verifiers

A verifier is a legal entity conducting verification activities (Article 3(27)). To be entitled to conduct verification activities, the verifier needs to be accredited by a National Accreditation Body (NAB) (please refer to Section 2.3.3 for more details).[6]

The verifier has to be independent of the company or the ship operator, according to Article 12(1). This means that the verifier cannot be part of a company, ship operator or owner of a company, nor can the verifier be owned by one of these entities. The verifier needs to be fully independent and impartial to perform its tasks under the Regulation.

Under the FuelEU Maritime Regulation, **verifiers have two main responsibilities**: (i) verification of compliance at the ship level and (ii) verification of compliance at the pool level:

- **Verification of compliance at the ship level** concerns all relevant activities for an individual ship. For instance, they verify the ship's monitoring plan and its FuelEU Report. They are also the ones who issue the FuelEU DoC in case the ship has no deficit after the application of the flexibility mechanisms.
- **Verification of compliance at the pool level** is done when several ships decide to form a pool to meet the FuelEU requirements (see Section 11.3 for a detailed description of pooling). Once the ships jointly meet those requirements, the outcomes will be verified by the pool verifier. If the pool is indeed compliant, this information is communicated to the ship-specific verifiers. **The pool can select one of the ship-specific verifiers to become the pool verifier as well, or they can appoint a new verifier**.

In a nutshell, the verifier is responsible for:

- Verifying and satisfactorily assessing the monitoring plan
- Verifying and satisfactorily assessing the revised monitoring plan
- Performing the verification assessment on the FuelEU report

[6] This obligation stems from Article 14 of the FuelEU Maritime Regulation.

- Notification of verification report
- Calculating the GHG intensity
- Verifying the compliance balance
- Recording of compliance balance in the FuelEU database
- Approving borrowing and banking
- Recording of the composition of the pool and allocation to the ships that form a pool.
- Issuing the FuelEU DoC
- Recording the FuelEU DoC in the FuelEU database
- Recording the total hours spent moored at the quayside by the ship in non-compliance

Verifiers conduct the verification activities for both the FuelEU Maritime and the EU MRV. In most cases, the verifier chosen for the EU MRV will also perform verification activities for FuelEU Maritime. However, shipping companies can select a different verifier.

For more details on the verification process, please refer to Sections 8.2, 9.2 and 10.2.

2.3.3 National accreditation bodies

Verifiers can only conduct their verification activities if they have been accredited by an NAB. NABs perform the accreditation according to specific requirements laid down in the FuelEU Maritime Regulation and the general provisions of Regulation (EC) No 765/2008 on accreditation and market surveillance.

As part of the FuelEU Maritime Regulation, a Delegated Act has been adopted,[7] which provides further details on the accreditation process. This relates, for instance, to the scope of the accreditation. NABs need to assess the procedures verifiers have in place for the assessment of monitoring plans, verification of (partial) FuelEU reports, verification of conformity with GHG intensity requirements by calculating the GHG intensity of the energy used onboard, the compliance balance, non-compliant port calls and issuance of the FuelEU DoC.

For each of those documents and elements, the NABs need to follow a harmonised assessment process to ensure that each verifier is assessed similarly. The Delegated Act, therefore, indicates how the accreditation needs to be conducted. This way, each verifier is assessed similarly, irrespective of the NAB involved.

In case the verifier complies with the requirements, the NAB should issue an accreditation certificate. **This certificate is valid for a maximum period of 5 years**. After this period, the verifier needs to apply for a renewal of the accreditation. Otherwise, the verifier is no longer allowed to perform verification activities under the FuelEU Maritime Regulation.

In the validity period, the NAB should conduct **annual surveillance** to assess whether the activities conducted by the verifier remain in line with the verification requirements. In addition, the NAB could perform **an extraordinary assessment**. Such an assessment should be conducted in case significant changes occur on the side of the verifier, which could influence

[7] For more information, please refer to: Commission implementing regulation - EU - 2024/2027 - EN - EUR-Lex.

the activities of the verifier. If the verifier does not comply with the requirements, the NAB can impose an administrative measure on the verifier. This means that **the NAB can suspend or withdraw the accreditation of the verifier**. The verifier is then no longer allowed to perform any verification activities.

As the responsible accreditation body, the NAB can also receive complaints about all verifiers accredited by the NAB. Companies, as well as flag States and other interested parties, can file a complaint against a specific verifier. The NAB should respond to the complaint within three months. During this period, the NAB need to ensure that the verifier is given the opportunity to submit its observations. The NAB should respond to the complaint based on all information.

Number of NABs available

In each Member State, only one NAB can be appointed to accredit verifiers. A full overview of NABs in Europe can be found in the Directory of EA Members and MLA signatories - European Accreditation.

NABs can accredit verifiers based in their own Member State. In certain cases, NABs can also accredit verifiers based in another Member State. This could happen when there is no NAB in that Member State or if that NAB failed the peer review.

By the end of each year, **each NAB is obliged to publish a list of accredited verifiers**. The list will contain the following information:

- Verifier's contact information
- The validity period for the accreditation
- If relevant, administrative measures imposed on the verifier

This list is shared with the Commission and often published on the website of the NAB itself.

Only one NAB can be appointed per Member State. Therefore, the NAB is also responsible for the accreditation under the EU MRV Regulation. The procedure followed for accreditation is highly similar as well.

2.3.4 National authorities

Several national authorities play a part in the FuelEU Maritime Regulation. This concerns the following authorities:

- The administering State[8]
- The flag State authority
- The port State authority[9]

[8] In the Regulation referred to as the competent authority of the administering State in respect of a company. For clarity we refer to Administering State in this section.

[9] In the Regulation referred to as the competent authority of the Member State of the port of call or any duly authorised entity. For clarity we refer to the port State authority in this section.

Administering State

The administering State is the State in which the administering authority is located. The allocation of companies to administering States is the same as applied under the EU ETS.[10] Under the EU ETS, only EU Member States can be an administering State in respect of a company.

For each company, **there is only one authority in an individual Member State**. To determine the relevant administering authority for a company, the following criteria were formulated as part of the EU ETS Directive:[11]

- In the case of a company registered in an EU Member State, it is the EU Member State where the company is registered.
- In the case of a company not registered in an EU Member State, it is the EU Member State with the greatest estimated number of port calls from voyages performed by that company over the last four monitoring years and falling within the scope of the EU ETS Directive.
- In case of a company that is not registered in an EU Member State and that did not carry out any voyage covered by the EU ETS Directive in the preceding four monitoring years, the administering State is the EU Member State where the company's ship has arrived or has started its first voyage falling within the scope of the EU ETS Directive.

The list of shipping companies and the respective administering State will be available on THETIS MRV.

The administering State plays a role when a ship has a compliance deficit and needs to pay a penalty. **The administering State is responsible for collecting the penalty** (Article 23(3)). Once the company has paid within the required timeframe, **the administering State will issue the FuelEU DoC** (Article 22(2)).

For more information on penalties, please refer to Chapter 12.

Besides issuing FuelEU Documents of Compliance and collecting penalties, **the administering State can, at any time, conduct additional checks** (Article 17) in relation to the two previous reporting periods. The checks can be done related to the following documents and activities:

- The FuelEU report
- The verification report
- The calculations made by the verifiers

[10] Article 3(40) and Legal provisions of COM(2021)551 - Amendment of 2003/87/EC establishing a system for greenhouse gas emission allowance trading within the Union and 2015/1814 on the market stability reserve - EU monitor.

[11] Article 3(40) FuelEU Maritime Regulation jo. Article 3gf (1) of the EU ETS Directive.

Flag State authority

The role of the flag State in the FuelEU Maritime Regulation is limited. When other Member States sanction or expel a ship, they need to inform the relevant flag State. Specifically, this is the case when:

1. A port State, in case of non-compliance of the ship, decides to impose an expulsion order. In that case, the ship can only return to a port in the flag State as all other States are obliged to refuse the ship (Article 25(3)).
2. A Member State imposes a sanction on the ship (Article 25(5)).

Port State authority[12]

Once a ship enters an EU port, **a Member State in its capacity as a port State can perform checks on the ship**. EU Member States need to ensure that any inspection of a ship in a port under its jurisdiction is conducted following the general requirements laid down in the Port State Directive and specific requirements laid down in the FuelEU Maritime Regulation.[13]

Most important for the FuelEU Maritime Regulation is a check **whether a valid FuelEU DoC is carried onboard the ship** (Article 25(2)). In case the ship is non-compliant, the port State needs to follow up through effective, proportionate, and dissuasive sanctions, which follow from an established system of penalties. Such penalties are laid down in national law pursuant to the port State Directive and the FuelEU Maritime Regulation.

In case a ship fails to carry a valid DoC for two or more consecutive years, the Member State can decide to issue an expulsion order for the ship. In this case, the Member State needs to inform the Commission, other Member States, and the relevant flag State.

For more information, please refer to Section 12.2.

Summary – national authorities

Based on the above, the roles of national authorities can be summarised as follows in Table 2.1:

Table 2.1 Role of national authorities

State referred to	Countries covered	Main role
Administrating State	EU27 Member States + EEA countries	Can impose sanctions in case of non-compliance
Flag State	All countries worldwide	Needs to be informed in case of sanctions
Port State	The 22 coastal Member States, Iceland, and Norway	Can impose sanctions in case of a missing FuelEU DoC

[12] The port State authority here refers to the Competent authority as defined in Article 2.9 of Directive 2009/16/EC on port State control.

[13] For more information please refer to: Directive - 2009/16 - EN - EUR-Lex.

3 Scope

The scope of the FuelEU Maritime Regulation is laid down in Article 2. This chapter provides details on (i) the geographical scope of the Regulation (i.e. which countries are covered), (ii) the ships covered and exempted (i.e. which ships needs to fulfil the obligations laid down in the Regulation), (iii) the voyages covered (i.e. which trips need to be monitored and which % of energy used needs to reported on) and (iv) emissions covered (i.e. which emissions need to be monitored and how).

3.1 Geographical scope

The Regulation applies to all 27 EU Member States and the EEA countries.[14] [15] However, based on Recital 12, Member States without maritime ports on their territory, ships flying their flag, accredited verifier(s), and which are not an administering State within the Regulation's meaning, do not have to take action concerning the requirements.

Some EU Member States have regions located outside mainland Europe. For some of those regions, the requirements laid down in the Regulation will apply, while for others they will not. An important distinction is whether a port is located in an **outermost region** or an **Overseas Country and Territory**.

Defining port calls in outermost regions

The Regulation applies to the regions that are outermost regions as specified in Article 349 Treaty on the Functioning of the European Union (TFEU). In order to apply the Regulation, it is therefore important to know which regions qualify as outermost regions. In total, **nine regions qualify as an outermost region** (see Table 3.1).

[14] It is important to note that the Faroe Islands, a self-governing nation within the Kingdom of Denmark, are not covered by the founding treaties (see Article 355 (5)(a)) and are therefore treated as a third country.

[15] Please note that at the moment of the drafting of this guidance document (October 2025), the FuelEU Maritime Regulation is not yet incorporated into the EEA Agreement. The FuelEU Maritime Regulation should be applicable in Norway and Iceland from the date it is incorporated in the EEA Agreement. Before the date of the incorporation, port calls in Norway and Iceland are considered as port calls outside the scope of FuelEU Maritime Regulation and therefore the same regime as the one applicable to third countries applies.

Table 3.1 Overview of outermost regions per Member State

Member State	Outermost region
France	• French Guyana • Guadeloupe • Martinique • Mayotte • Reunion • Saint Martin
Portugal	• Azores • Madeira
Spain	• Canary Island

Source: Article 349 TFEU

Although the Regulation does apply to port calls made in these regions, it is important to note that an exemption has been included in the Regulation (see Section 3.3, Article 2(1), Article 2(4), and Recital (15) for these nine regions.

Defining port calls in OCT

The Regulation does not apply to regions that are Overseas Countries and Territories (OCT) as specified in Article 198 TFEU. This means that **they are treated as a third country**. The OCTs identified are:

Table 3.2 Overview of OCT

Member State	OCT
Denmark	• Greenland
France	• French Polynesia • French Southern and Antarctic Territories • New Caledonia • Saint Barthélémy • Saint Pierre and Miquelon • Wallis and Futuna
The Netherlands	• Aruba • Bonaire • Curaçao • Saba • Sint Eustatius • Sint Maarten

Source: Article 198 TFEU jo Annex II TFEU

Port calls in EEA countries

In addition, the Regulation has EEA relevance and therefore also applies to port calls made in Iceland and Norway. The only exception is the Norwegian port of Svalbard.[16] **Svalbard is treated as a port located in a third country**.

[16] Svalbard is excluded based on Protocol 40 accompanying the Agreement on the EEA.

The EEA Agreement has not yet incorporated the FuelEU Maritime Regulation at the time of the drafting of this guidance document (October 2025). As such, port calls in these countries are treated as port calls in a third country.

Liechtenstein is also an EEA country. As the country is landlocked and therefore no port calls can be made, the FuelEU Maritime Regulation is only relevant for Liechtenstein in case an ISM company is registered in Liechtenstein.

3.2 Covered and exempted ships

The Regulation applies to all ships with a GT above 5,000 that are used to transport passengers and/or cargo for commercial purposes (Article 2(1)) to or from an EEA port.[17] The Regulation applies to these ships irrespective of their flag, **ensuring flag neutrality**. This means that if a ship changes its flag, its obligations under the Regulation will not be affected.

Some ship types that fall within the scope stated in the paragraph above are exempted. According to Article 3(7), the Regulation does not apply to:

- **Warships** - meaning all ships operated by armed forces and used exclusively by governments for military purposes or engaging in crisis response or humanitarian relief operations.
- **Naval auxiliaries** - meaning all ships engaged in supply operations to military ships, including fuel and cargo, or engaged in crisis response or humanitarian relief operations.
- **Fish-catching or fish-processing ships** - covering a large range of ships engaged exclusively in fishing activities.
- **Wooden ships of a primitive build**.
- **Ships not propelled by mechanical means** - excluding all sailing ships that can be mechanically propelled.
- **Ships owned or operated by a government** used for non-commercial purposes.

Notably, ships which do not serve the purpose of transporting cargo or passengers for commercial purposes are not in scope of the Regulation.

[17] According to Recital 11, the Commission should regularly assess the situation to eventually extend the scope to ships with a GT below 5000 GT. A scope extension would ensure coherence with the scope extensions of both the EU MRV Regulation and the EU ETS Directive.

3.3 Covered voyages

3.3.1 Covered voyages – the main rules

The Regulation focuses on the energy used on board the ship. The Regulation includes (i) energy used when the ship stays in a port of call under the jurisdiction of a Member State, (ii) when it operates between Member State ports, or (iii) either arrives/departs from a Member State port. Defining the 'port of call' is therefore key. **Similar to the EU-MRV, the port of call is defined as the start and the end of a voyage**. It means the port where a ship stops to load or unload cargo or to embark or disembark passengers.[18]

Ships' movements that do not serve the purpose of transporting cargo or passengers for commercial purposes are not in the scope of FuelEU, for example:

- prospection and extraction of material from the seabed or subsoil
- ice-breaking activities
- carrying, laying, and repairing cables/pipelines for underwater telecommunications, electric power transmission, or other purposes
- providing support to offshore installations, such as drilling rigs, natural gas and oil platforms, offshore wind farms, and including in particular
  - carriage and positioning of anchors for drilling rigs
  - providing towage, salvage, or other marine assistance/services to offshore installations
  - carriage of supplies and equipment to/ from offshore installations and ships
  - safety or rescue services provided to offshore installations
  - diving support
  - storing oil or gas without processing it
  - installation and decommissioning of subsea structures and offshore installations

According to Article 2(1), the following main rules apply:

Energy used during a stay within a port of call

- 100% of the energy used during a stay in a port under the jurisdiction of a Member State (e.g. in the port of Antwerp). It is important to note that this requirement also applies to energy used during the stay in a port located in an outermost region (e.g. Le Port Réunion).

- 0% of the energy used during a stay in a port under the jurisdiction of a third country (e.g. in the port of Shanghai).

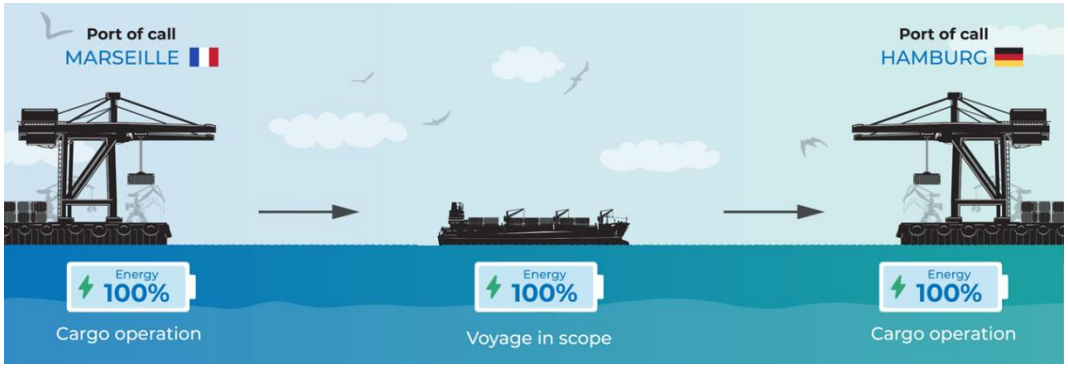
A temporary exemption on energy used in a port is provided as a possibility under Article 2(4) for the energy used on board in a port of call located in an outermost region under the jurisdiction of the Member State. In case a ship makes port calls in two ports located in an outermost region, the energy used while staying in the ports can be fully exempted from the scope of the Regulation. Such exemptions can be granted until 31 December 2029. For an up-to-date list, please refer to the Commission's website.

[18] For more information please refer to the EU ETS and MRV Maritime General guidance for shipping companies Guidance document No. 1.

Voyages within the jurisdiction of EU Member States (European mainland)

- 100% of the energy used on voyages departing from a port under the jurisdiction of a Member State and arriving at a port under the jurisdiction of a Member State (e.g. Marseille to Hamburg and Hamburg to Marseille).

Figure 3.1 Example of voyage covered within the jurisdiction of EU Member States



Source: Authors, based on the FuelEU Maritime Regulation

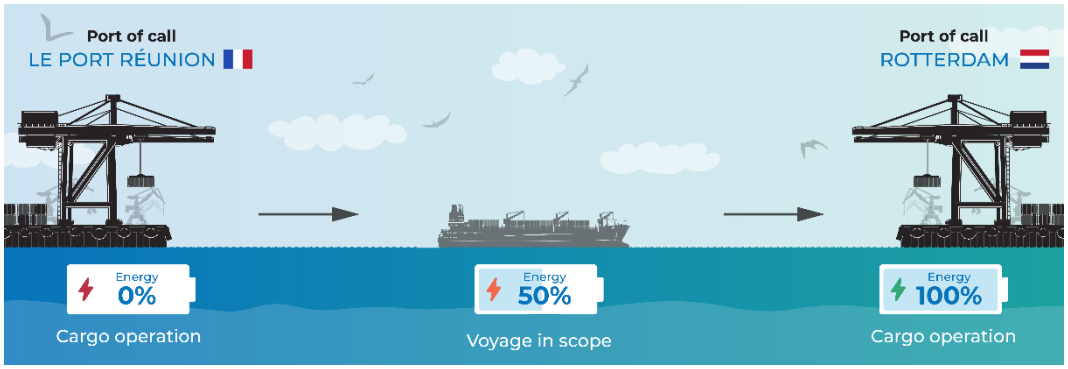
Voyages to and from a port in an outermost region within the jurisdiction of EU Member States

- 50% of the energy used on voyages between a port under the jurisdiction of a Member State and a port in an outermost region within the jurisdiction of a Member State (e.g. Le Port Réunion to Rotterdam).

- 50% of the energy used on voyages between a port in an outermost region within the jurisdiction of a Member State and a port not under the jurisdiction of a Member State (e.g. Le Port Réunion to Shanghai).

- 50% of the energy used on voyages between two ports in an outermost region within the jurisdiction of a Member State. Notwithstanding possible temporary exemptions as explained in Section 3.3.2.

Figure 3.2 Example of a voyage from a port in an outermost region within the jurisdiction of an EU Member State[19]



Source: Authors, based on the FuelEU Maritime Regulation

[19] Based on Article 2(4) the energy used in a port in an outermost region can be exempted. When this is done, energy used is not included in the calculations and therefore counts as 0%.

Voyages only partially within the jurisdiction of EU Member States

- 50% of the energy used on voyages departing from a port under the jurisdiction of a Member State and arriving at a port outside the jurisdiction of a Member State (e.g. Hamburg to Shanghai).

- 50% of the energy used on voyages departing from a port outside the jurisdiction of a Member State and arriving at a port under the jurisdiction of a Member State (e.g. Shanghai to Hamburg).

Figure 3.3 Example of a voyage only partially within the jurisdiction of EU Member States

Source: Authors, based on the FuelEU Maritime Regulation

3.3.2 *Voyages covered - Temporary exemptions.*

Several temporary exemptions to the main rules presented above have been formulated. It is up to the discretion of the Member State concerned to grant such an exemption.[20] An overview of all temporary exemptions can be found on the Commission's website.

Member States with island regions

Several Member States have islands.[21] These islands depend on maritime transport to stay connected with the mainland. The FuelEU Maritime Regulation introduces several temporary exemptions. The following are introduced:

Based on Article 2(3), it is possible for the Member State to **temporarily exempt voyages of passenger ships other than cruise ships between a port on the island and a port on the mainland**, as long as the ports are both located within the same Member State. Additionally, **the island needs to have fewer than 200,000 permanent residents** (e.g. voyages between Valencia and Ibiza). A visual presentation of such exemptions can be found in Figure 3.4.

[20] The requests for these exemptions must be forwarded by Member States to the European Commission and will be published by the Commission in the Official Journal of the European Union. They are subject to a time limit, with an expiration date no later than December 31, 2029.

[21] Although 'island' is not officially defined in EU law, it generally refers to an island that can be reached only by sea or air and which has no permanent land links with the European mainland. Accordingly, a peninsula which remains permanently linked to the mainland by road or rail cannot be considered as an island. Please refer to COM (2014) 232, final - page 11.

Figure 3.4 Example of a temporary exemption for Member States with islands

Source: Authors, based on the FuelEU Maritime Regulation

Another exemption available for Member States with islands is the option to **temporarily exempt voyages to islands by passenger ships that are part of a public service contract or subject to a public service obligation**. Again, both ports need to be located in the same Member State (e.g. voyages between Civitavecchia and Olbia). A visual presentation of such exemptions can be found in Figure 3.5.

Figure 3.5 Example of a temporary exception for passenger voyages to islands that are part of a public service obligation

Source: Authors, based on the FuelEU Maritime Regulation

Two ports, **the Port of Ceuta and the Port of Melilla**, both located on the North African coast but being part of Spain, **can be granted a temporary exemption** as well. They can be treated as island ports and therefore follow the same exemptions as those laid down in Article 2(6).

Island Member States

Several Member States, specifically Cyprus, Ireland, and Malta, do not share a land border with any other Member State. Therefore, they are dependent on maritime transport, especially for the connectivity of their citizens. These Member States could grant a **temporary exemption for voyages of passenger ships based on a public service contract or public service obligation** (see Article 2(5)).

Figure 3.6 Example of a temporary exemption for island States

Source: Authors, based on the FuelEU Maritime Regulation

Voyages between ports in outermost regions

Based on Article 2(4), Member States can grant a **temporary exemption for voyages between ports located in an outermost region**. This exemption applies to passenger as well as cargo ships. The outermost regions do not have to be part of the same Member State (e.g. voyages between Guadeloupe and Martinique (both French regions), but also voyages between the Canary Islands (part of Spain) and the Azores (part of Portugal). This example is visually demonstrated by Figure 3.7.

Figure 3.7 Example of a temporary exemption for outermost regions

Source: Authors, based on the FuelEU Maritime Regulation

3.3.3 *Exclusion cases – activities which do not count as a port of call*

The FuelEU Maritime Regulation does exclude several activities from the definition of port of call. This list is almost identical to the list of excluded activities under the EU MRV Regulation.[22] **The following activities are excluded from the definition of port of call**:

- stops for the sole purposes of refuelling, obtaining supplies
- relieving the crew of a ship[23]
- going into dry-dock or making repairs to the ship and/or its equipment
- stops in port because the ship requires assistance or is in distress
- Ship-to-ship transfers conducted outside ports

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22 This list can be found in Section 2.2.3 of EU ETS and MRV Maritime General guidance for shipping companies (however see the footnote 5 on 'relieving the crew of a ship').

23 Note that in the context of the EU MRV, stops to relieve the crew of an offshore ship (but only that ship type) are considered a port of call. However, offshore ships are not inside the FuelEU Maritime Regulation's scope.

- stops for the sole purpose of taking shelter from adverse weather or is rendered necessary by search and rescue activities
- stops of containerships in identified neighbouring container transhipment ports

Mentioned stops generally do not qualify as a port of call under the FuelEU Maritime Regulation. However, if a ship is on a voyage that falls within the scope of the regulation due to its previous or next stop, the emissions generated during these stops are effectively considered part of the voyage and must be monitored and reported.

Guidance on the potential monitoring and reporting implications of these activities is available in the EU MRV/ETS guidance documents (Section 2.2.3 of Guidance Document no. 1 – General guidance for shipping companies: the EU ETS and MRV Maritime).

'Exempted voyages' including port activity) must still be monitored. Later, (and pending verification), the total energy consumed during these voyages/port calls may be excluded from the ship's final annual GHG intensity.

3.3.4 Sailing in ice conditions

Companies operating ice-class ships can apply a limited adjusted amount of energy used on board the ship. In addition, a **temporary exemption can be given for when such ships sail through ice**. The additional energy needed to navigate through ice can be exempted from the calculations (see Recital 19).

Note that **there are 2 different kinds of exemptions for ice-class ships**:

1. A deduction of additional energy used when sailing in ice conditions.
   - This is possible for ships of a wider range of ice classes: IA Super, IA, IB and IC (or equivalent)
   - This deduction is valid only until 31 December 2034 (with a possibility of extension subject to a review under Article 30 of the Regulation)
2. A deduction of 5% of the total energy used onboard in the reporting year due to the technical characteristics of a ship with a given ice class.
   - This is only possible for ships with the highest ice classes, being IA Super or IA (or equivalent)
   - This deduction does not have an end date (but may be subject to review under Article 30 of the Regulation)

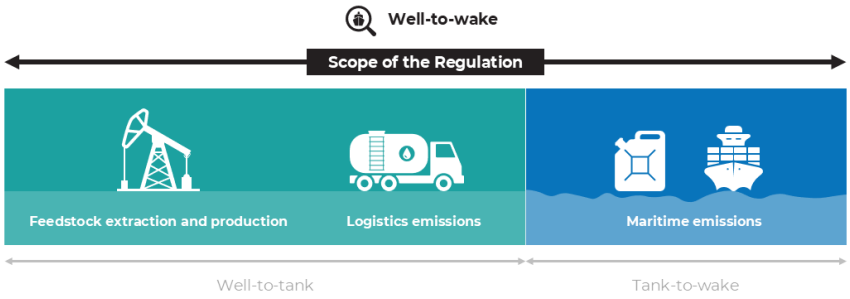
3.4 GHG emissions covered

The Regulation aims to limit the GHG intensity of energy used onboard ships arriving at, staying within, or departing from a Member State port (Article 1(a)). The term GHG intensity means the annual amount of GHG emissions released on a Well-to-Wake basis per Megajoule (MJ) of energy used onboard.

- **Wel-to-Tank (WtT)** covers the emissions associated with the extraction and production of the fuel until it gets to the fuel tanks onboard the ship.
- **Tank-to-Wake (TtW)** covers the emissions from the ship itself, i.e. those released from the ship's exhaust gas.
- Together, these are referred to as **Well-to-Wake (WtW)**.

Inclusion of WtT +TtW emissions for all fuel types in FuelEU represents a major difference between FuelEU and the EU ETS for shipping, which, in general, covers only Tank to Wake emissions.[24]

Figure 3.8 Emissions covered in the FuelEU Maritime Regulation



Source: Authors, based on the FuelEU Maritime Regulation

GHG emissions included in the scope of the FuelEU Maritime Regulation are CO_2, methane (CH_4), and Nitrous Oxide (N2O) (see Article 3(1)). These gases are collectively described as CO_2e (CO_2 equivalent). More information on these GHGs, including the Global Warming Potential values used in the scope of FuelEU to aggregate the different emissions, can be found in Chapter 4.

[24] However, certain fuels may be zero-rated under EU ETS with the application of rules from the MRR for biofuels, RFNBO/RCFs and Synthetic Low Carbon Fuels (SLCFs). Full details on this can be found in Section 5.2.2 EU ETS and MRV Maritime General guidance for shipping companies.

Part I – Requirements for energy used on board by ships

4 Annual GHG intensity limits for energy used on board

This chapter discusses the GHG intensity limits set by Article 4 of the FuelEU Maritime Regulation, including the meaning of the term and how it is calculated. The chapter also discusses factors that influence GHG intensity for a ship, including the fuels used and the installation/use of different technologies onboard.

4.1 The meaning of GHG intensity

GHG intensity is a central concept in the FuelEU Maritime Regulation. It **refers to the annual average amount of GHG emissions emitted by a ship per unit of energy used on board by the ship**.

Under the Regulation, a ship's GHG intensity is measured in grams of CO_2 equivalent (gCO_2eq) per MJ of energy used and is, in simple terms, calculated on an annual basis as follows:

$$\frac{\text{Amount of yearly WtW GHG emissions in scope of FuelEU by a ship expressed in grams of } CO_2 \text{equivalent}}{\text{Amount of yearly energy used on board in scope of FuelEU by a ship expressed in MJs}}$$

As such, the ultimate objective of the FuelEU Maritime Regulation is, in contrast to the EU ETS, not to reduce the absolute amount of GHGs emitted by ships but rather to improve the ships' GHG intensity, i.e. to **decrease the amount of GHG emissions released per MJ energy used by ships**. By setting limits on the annual GHG intensity of a ship in scope, the Regulation incentivises the uptake of renewable and low-carbon fuels and substitute sources of energy by ships.

Article 4 defines GHG intensity limits for ships in scope of the Regulation. The limits are set out in Table 4.1 with the required reduction being set against a reference value of 91.16 gCO_2eq/MJ. The reference value was established based on the ships that reported to the EU MRV in 2020. As can be seen, FuelEU GHG intensity limits have been set in 5-year periods and get incrementally stricter from 2025 to 2050.

Table 4.1 GHG intensity limits on energy used onboard by a ship

Reference date	Reduction required compared to the reference value	Actual calculated limits in gCO_2eq/MJ
2025	2%	89.34
2030	6%	85.69
2035	14.5%	77.94
2040	31%	62.90
2045	62%	34.34
2050	80%	18.23

Source: Authors, based on Article 4 of the Regulation

A ship's GHG intensity is calculated on an annual basis at the end of each reporting period (1 January to 31 December). In principle, a ship should have an annual GHG intensity below the given limit, but for ships above the limit, compliance can still be arranged by pooling or borrowing, or by paying a penalty. These alternative compliance options reflect a degree of flexibility in the Regulation, which recognises that direct compliance may depend on elements beyond the direct control of shipping companies, such as issues related to fuel availability.

4.2 Formula for establishing the GHG intensity of energy used on board

The full formula for establishing the GHG intensity of the energy used on board a ship in the scope of the FuelEU Maritime Regulation is set out in Annex I of the Regulation (see box below in green). This formula in turn relies on the use of two other formulas: one to establish the WtT emissions of the energy used by the ship (yellow box) and the other to establish the TtW emissions of the energy used by the ship (blue box).

GHG intensity:

$$GHG\ intensity\ \left[\frac{gCO_2eq}{MJ}\right] = f_{wind} \times (WtT\ +\ TtW)$$

Where f_{wind} is a reward factor for wind-assisted propulsion (explained in Section 3.6)

It can be seen that in order to apply the GHG intensity formula, the user must also determine the WtT and TtW GHG intensity of the energy used by the ship. Each of these also has its own formulae as follows:

Well to Tank (WtT) GHG emissions:

$$WtT\ = \frac{\sum_i^{n\ fuel} M_i\ \times\ CO_{2eq\ WtT,i}\ \times\ LCV_i}{\sum_i^{n\ fuel} M_i\ \times\ LCV_i\ \times\ RWD_i\ +\ \sum_k^c E_k}$$

Where:

- $M_{i,j}$ is the Mass of fuel i consumed by fuel consumer unit j (g fuel).
- $CO_{2eq\ WtT,i}$ is the WtT GHG emission factor of fuel i (g CO_2eq/MJ)

- LCV_i is the Lower Calorific Value of fuel i (MJ/g fuel)
- RWD_i is the reward factor of 2 that can be applied from 1 January 2025 to 31 December 2033 for the use of RFNBO (explained in Section 4.3.6)
- $\sum_k^c E_k$ is the sum of electricity delivered to the ship per onshore power supply (OPS) connection point k in MJ. Note that in the full formula in Annex I, emissions from electricity ($\sum_k^c E_k \times CO_{2eq\ electricity,k)}$ also appear in the numerator of the WtT formula; however, the same Annex clarifies that these can be set to zero, so are excluded above for simplicity.

Tank to Wake (TtW) GHG emissions:

$$TtW = \frac{\sum_i^{n\ fuel} \sum_j^{m\ engine} M_{i,j} \times \left[\left(1 - \frac{1}{100} C_{slip\ j}\right) \times \left(CO_{2eq,TtW,i,j}\right) + \left(\frac{1}{100} C_{slip\ j} \times CO_{2eq\ TtW,slip,i,j}\right)\right]}{\sum_i^{n\ fuel} M_i \times LCV_i \times RWD_i + \sum_k^c E_k}$$

Where:

- $CO_{2eq,TtW,i,j}$ is the TtW CO_2 equivalent emissions of combusted fuel in fuel consumer unit j (g CO_2eq/g Fuel).
  - The TtW CO_2 equivalent emission intensity includes CH_4 and N_2O emissions from fuels as part of $CO_{2eq\ TtW}$. Reference is made to Columns 7 and 8 of the table in FuelEU Annex II, which provides default CH_4 and N_2O emission factors (in gCH_4/g fuel and gN_2O/g fuel, respectively).
  - These factors are required to calculate the $CO_{2eq\ TtW}$, which is defined in FuelEU Annex I as Equation (2):

$$CO_{2eq,TtWi,j} = (C_{fCO_{2,i}} \times GWP_{CO_2} + C_{fCH_{4,j}} \times GWP_{CH_4} + C_{fN_2O_j} \times GWP_{N_2O})_i$$

The term *GWP* is explained in Section 4.3.3

- $C_{slip\ j}$ is the non-combusted fuel coefficient as a percentage of the mass of the fuel i consumed by fuel unit j. C_{slip} includes fugitive and slipped emissions.
- $CO_{2eq,TtW,slip,i,j}$ is the TtW CO_2 equivalent emissions of slipped fuel i towards fuel consumer unit j (g CO_2eq/g Fuel). Default values for the % mass of fuel non-combusted and slipped as TtW emissions are provided in the table in FuelEU Annex II. In case no slippage coefficient is provided in the table in FuelEU Annex II, it should be assumed as zero.[25]
- The slipped amount is a separate element in the TtW formula. While C_{slip} is deducted in the calculation of **combusted** fuel emissions, slip is separately accounted for by its impact on the total TtW emission intensity.
- The added slip emission intensity ($\frac{1}{100} C_{slip\ j} \times CO_{2eq\ TtW,slip,i,j}$) follows from Annex I as:

$$\frac{1}{100} C_{slip\ j} \times CO_{2eq\ TtW,slip,i,j} = \left(\frac{1}{100} C_{slip\ j} \times \left(C_{sfCO_{2,j}} \times GWP_{CO_2} + C_{sfCH_{4,j}} \times GWP_{CH_4} + C_{sfN_2O_j} \times GWP_{N_2O}\right)_i\right.$$

where $C_{sfCO_{2,j}}$ and $C_{sfN_2O_j}$ = 0, and $C_{sfCH_{4,j}}$ = 1

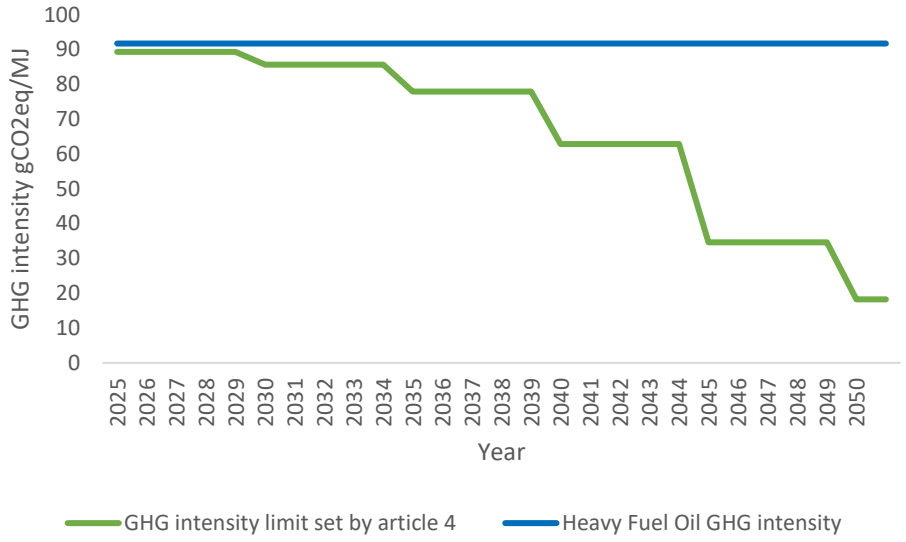
The fuel a ship uses has a major bearing on the ship's annual GHG intensity. However, fuel is not the only factor. A ship's use of electricity from an OPS connection point or the installation of a Wind-assisted Propulsion System (WAPS) can also play a role in reducing a ship's GHG

25 EU ETS and MRV Maritime General guidance for shipping companies Guidance document no.1 states that where default slippage coefficients are not listed for a specific emission source class, companies should apply a slippage coefficient of zero. However, future revisions of the regulation could include slippage for other gases.

intensity. These technologies are respectively addressed in Chapter 6 and 4.5 of this guidance document, while the present section focuses on fuel and its influence on a ship's GHG intensity under FuelEU.

To illustrate the influence of fuel on a ship's GHG intensity, Figure 4.1 presents the GHG intensity in gCO_2eq/MJ of a conventional fossil fuel, Heavy Fuel Oil (HFO) and compares it to the GHG intensity limits set by Article 4 of the Regulation.

Figure 4.1 GHG intensity limits expressed in Article 4, compared to the GHG intensity of HFO



Source: Own adaptation, based on GHG intensity limits presented in Article 4 and the reference value of 91,16 gCO_2eq/M

Figure 4.1 shows that HFO has a higher GHG intensity (91.74 gCO_2eq/MJ) than the initial GHG intensity limit set by the Regulation for 2025 - 2029 (which is 89.34 gCO_2eq/MJ). So, a ship using only HFO during a reporting year would have an annual GHG intensity above the limits set by Article 4, assuming no other technologies are used by the ship during the FuelEU reporting period.

To have an annual GHG intensity under the limits set by Article 4, **a ship would either have to consume lower GHG-intense fuels** (renewable and low-carbon fuels) **or lower the GHG intensity of the energy used onboard via technologies like OPS or WAPS**. This does not mean that a ship would have to use lower GHG-intense fuels during the *entire* year; however, it would need to use enough to lower the annual average GHG intensity for the reporting year.

4.3 Types of fuels and rules set in the Regulation

The FuelEU Maritime Regulation does not place any restrictions on the types of fuels that ships may use. However, there are some requirements set in the Regulation, or referred to within the Regulation, that are relevant for all fuels – such as default emission factors for the calculation of the GHG emissions and eventual possibilities to diverge from these. Where a ship uses renewable and/or low-carbon fuels, there are also certain rules on the production pathway of the fuel and GHG savings criteria which have to be abided by if the fuel is to count towards reducing the ship's annual GHG intensity.

This section first discusses default emission factors and where these can be found as specified in the Regulation. Possibilities to eventually deviate from these default values are then explained in Section 4.3.2. Section 4.3.3 subsequently also discusses the term 'global warming potential', which is important in determining the CO_2eq WtW emissions of a fuel. Later sub-sections discuss specific rules or provisions that are relevant for different fuel types.

4.3.1 Use of default emission factors from Annex II of the Regulation

A table in Annex II of the FuelEU Maritime Regulation provides default WtT and TtW emission factors for various fuels. To explain the functioning of this table, it is reproduced in Table 4.2 below for fossil fuels.[26] In Table 4.3, an example WtW GHG intensity calculation is given for Marine Diesel Oil (MDO), explaining where the relevant values for the calculation can be found from the table in FuelEU Annex II.

Annex II Default emission factors of the FuelEU Maritime Regulation are not exhaustive in providing emission factors. In some cases, the term 'TBM' (To Be Measured) or N/A (Not Available) can be noted in a column. Where a cell indicates either TBM or N/A, unless a value is demonstrated in accordance with Article 10, the highest default value of the fuel class in the same column shall be used. Where, for a particular fuel class, all cells in the same column indicate either TBM or N/A, unless a value is demonstrated in accordance with Article 10, the default value of the least favourable fossil fuel pathway shall be used.[27]

In Table 4.2, default values have been used for LPG, H_2 ICE, NH_3 and methanol, being 0.00005 gram CH_4 per gram fuel and 0.00018 gram N_2O per gram fuel.

The Commission is also empowered to adopt delegated acts to amend Annex II to include the WtW emission factors related to any new sources of energy or to adapt the existing emission factors to ensure consistency with future international standards or Union legal acts in the field of energy, in accordance with the best available scientific and technical knowledge.

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[26] Only these since for other fuels far less default values are available.

[27] This rule does not apply to the column which identifies the part of fuel lost as fugitive and slipped emissions (Cslip), which is column 9 in Annex II of the Regulation. In this column TBM or N/A refers to non-available values for the fuel consumer. In case of no default value, a certified value in accordance with Article 10(5) should be used.

Table 4.2 Reproduction of FuelEU Annex II showing fossil fuel parameter values

Corresponding FuelEU Annex II Column	3	4	6	7	8	9
		WtT	TtW			
Pathway name / Consumer	**LCV** [MJ/g]	**CO_2eq WtT** [gCO_2eq/MJ]	**$C_{f\ CO2}$** [$gCO_2/gFuel$]	**$C_{f\ CH4}$** [$gCH_4/gFuel$]	**$C_{f\ N2O}$** [$gN_2O/gFuel$]	**C_{slip}** [%]
HFO (Grades RME to RMK)	0.0405	13.5	3.114	0.00005	0.00018	0.0%
LFO (Grades RMA to RMD)	0.0410	13.2	3.151	0.00005	0.00018	0.0%
MDO MGO (Grades DMX to DMB)	0.0427	14.4	3.206	0.00005	0.00018	0.0%
LNG / LNG Otto (dual fuel medium speed)	0.0491	18.5	2.750	0.00000	0.00011	3.1%
LNG / LNG Otto (dual fuel slow speed)	0.0491	18.5	2.750	0.00000	0.00011	1.7%
LNG / LNG Diesel (dual fuel slow speed)	0.0491	18.5	2.750	0.00000	0.00011	0.2%
LNG / LBSI	0.0491	18.5	2.750	0.00000	0.00011	2.6%
LPG - Butane	0.0460	7.8	3.030	0.00005	0.00018	0.0%
LPG - Propane	0.0460	7.8	3.000	0.00005	0.00018	0.0%
H2 (natural gas) / Fuel Cells	0.1200	132.0	0.000	0.00000	0.00000	0.0%
H2 (natural gas) / ICE	0.1200	132.0	0.000	0.00000	0.00018	0.0%
NH3 (natural gas) / Fuel Cells	0.0186	121.0	0.000	0.00005	0.00018	0.0%
NH3 (natural gas) / ICE	0.0180	121.0	0.000	0.00005	0.00018	0.0%
Methanol (natural gas)	0.0199	31.3	1.375	0.00005	0.00018	0.0%

Source: ESSF WS1 – Report On calculation methodologies under Regulation (EU) 2023/1805

To illustrate how these default values should be used to determine the fuel's total WtW intensity, a detailed breakdown is provided in Table 4.3 for MDO (see also the blue box in Table 4.2).

Table 4.3 Steps to determine the WtW GHG intensity of MDO (see also blue box in Table 4.2)

Step	Value (gCO_2eq/MJ)	Notes on how to obtain the value
1. WtT (WtT) emissions	14.4	1. This value can be found directly in Annex II of the Regulation (see column 4). 2. For fossil fuels, the default WtT emission factors must always be applied.
2. TtW CO_2 emissions	75.08	3. This value can be derived from Annex II of the Regulation by taking the emission factor (Cf) for CO_2 for the fuel (3.206 gCO_2 per gram of fuel, see column 6), divided by the LCV of the fuel (0.0427 MJ/gram, see column 3)
3. TtW CH_4 emissions	0.03	4. This value can be derived from Annex II of the Regulation by taking the CH_4 emission factor (C_f) for the fuel (0.00005 per gram fuel), divided by the LCV of the fuel (0.0427 MJ/gram) 5. This calculated value (0.0012 g CH_4/MJ) must then be multiplied by 25, which is the Global Warming Potential of CH_4 over 100 years presently applied for FuelEU[28]
4. TtW N_2O emissions	1.26	6. This value can be derived from Annex II of the Regulation by taking the N_2O emission factor (C_f) for the fuel (0.00018 gCO_2e per gram of fuel, see column 8), divided by the LCV of the fuel (0.0427 MJ/gram) 7. This calculated value (0.0042 g N_2O/MJ) must then be multiplied by 298, which is the Global Warming Potential of N_20 over 100 years presently applied for FuelEU
Adding the values of steps 1 (WtT) together with steps 2 - 4 (TtW) gives a total WtW GHG intensity = 14.4 + 75.08 + 0.03 + 1.26 = 90.77 gCO_2eq/MJ		

Source: Authors, based on FuelEU FAQs and Annex II of the FuelEU Maritime Regulation.

Note that for non-conventional fuels, the WtW and TtW values are much more variable, depending on the production pathway and the exact specification of the fuel delivered to the ship. As such, not all emission factors for each fuel type are available directly from Annex II of the FuelEU Maritime Regulation. Instead, emission factors need to be gathered based on information received from fuel suppliers and from cross-referencing to other EU legal acts (see Chapter 5 for more information).

[28] See also Section 4.3.3 for an explanation on the Global Warming Potential values used for FuelEU.

Slipped emissions

For certain fuels, the steps to determine the WtW GHG intensity of the fuel must also **consider 'slip' of the fuel used by the engine**. Values for 'slip' are found in column 9 in the table of Annex II of the FuelEU Maritime Regulation, which identifies the part of fuel lost as fugitive and slipped emissions (Cslip). Cslip is provided as % of the mass of fuel used by the specific fuel consumer unit. Emission slip occurs, according to Annex II of the FuelEU Maritime Regulation, for combusted Liquefied Natural Gas (LNG), Liquefied Petroleum Gas (LPG), NH3, Bio-LNG, e-LNG, e-NH3, e-LPG and e-DME.[29] Table 4.4 illustrates, as an example, how these Cslip values are to be used to determine the WtW emissions of LNG in a dual-fuel slow-speed engine. Note that since the slippage values are a characteristic of the energy converter/engine, and the possibility for improved emission performance should be rewarded, the FuelEU Maritime Regulation opens to the possibility of diverging from the default values for the TtW emission factors for slippage. The Commission is in the process of developing Guidelines on this matter as an interim solution until international standards and certification references are established and accepted within this scope. Until then, only default values shall apply.

Table 4.4 Steps to determine the WtW GHG intensity of LNG in an LNG Diesel dual fuel slow speed engine (see also green box in Table 4.2)

Step	Value (gCO_2eq/MJ)	Notes on how to obtain the value
1. WtT emissions	18.5	This value can be found directly Annex II of the Regulation (see column 4). For fossil fuels, the default WtW emission factors must always be applied.
2. TtW CO_2 emissions, including slippage	55.90	CO_2 emissions are calculated for the mass of fuel excluding slippage, so you apply a factor (1-C_{slip}) The C_{slip} value for LNG in this type of engine is 0.2% according to Annex II (1-0.2%) = 0.998 This value is then multiplied by the emission factor (Cf) for CO_2 for the fuel (2,750 gCO_2 per gram of fuel, see column 6). This calculated value is then divided by the LCV of the fuel (0.0491 MJ/gram);
3. TtW CH_4 emissions	1.02	Annex II gives a value of 0 gCH_4 per gram of fuel, so only slipped emissions need to be calculated. The value for CH_4 slippage for this engine type (.2% or .002 in this case) is multiplied by the global warming potential value for CH_4 used in FuelEU, which is 25. This calculated value is then divided by the LCV of the fuel (0.0491 MJ/gram)

[29] For LNG, bio-LNG and e-LNG, a default value Cslip value is provided whereas for LPG, NH3, e-NH3, e-LPG and e-DME the column states 'Not Available'. For these fuels a certified value in accordance with Article 10(5) should be used. For all other fuels the column states (-) meaning slippage is not applicable.

Step	Value (gCO_2eq/MJ)	Notes on how to obtain the value
4. TtW N_2O emissions	0.67	• N_2O emissions are calculated for the mass of fuel excluding slippage, so you apply a factor (1-C_{slip}) • The C_{slip} value for LNG in this type of engine is 0.2% according to Annex II (1-0.2%) = 0.998 • This value is then multiplied by the emission factor (Cf) for N_2O for the fuel (.00011 g N_2O per gram of fuel, see column 6), which results in 0.00011. This value is then multiplied by the global warming potential for N_2O used for FuelEU (298), which results in 0.033. • This calculated value is then divided by the LCV of the fuel (0.0491 MJ/gram)
Adding the values of steps 1 (WtT) together with steps 2 - 4 (TtW) gives a total WtW GHG intensity = 18.5 + 55.90 + 1.02 + 0.67 = 76.08 gCO_2eq/MJ		

Source: Authors, based on FuelEU FAQs and Annex II of the FuelEU Maritime Regulation.

4.3.2 Use of emission factors other than the default values provided in Annex II

In certain cases, shipping companies may also deviate from default values listed in Annex II of the FuelEU Maritime Regulation in the following ways:

1. **The use of WtT emission factors for fuels** other than fossil fuels, provided the actual values are certified to be in accordance with the RED or Gas and Hydrogen Directive by a scheme that is recognised by the Commission (see also Chapter 5 for a description of such schemes)
2. **The use of actual values for TtW emission factors for fuels** (except for CO_2 emissions from fossil fuels), provided that actual values are certified by means of laboratory testing or direct emissions measurements.
3. **The use of actual slipped emission values** instead of default values provided in Annex II, column 9 of the Regulation.

Actual, non-default values may be used following secondary legislation identifying which international standards, if any, are considered to be acceptable for this purpose. This secondary legislation is foreseen under Article 10(6) of the FuelEU Maritime Regulation, but is pending ongoing developments on the topic at the International Maritime Organization (IMO) level (where a correspondence group reporting to MEPC has been considering the topic). The Commission is in the process of developing Guidelines on this matter as an interim solution until international standards and certification references are established and accepted within this scope.

The possibilities for shipping companies to deviate from the default emission factors listed within Annex II of FuelEU are also illustrated in Table 4.5.

Table 4.5 Options to deviate from WtT and TtW emission factors for different fuel/energy types

Fuel category	WtT GHG emission factors	TtW emission factors	
		CO_2	N_2O & CH_4
Fossil fuels	Always default	Always default	Default unless other values are certified by laboratory testing or direct emissions measurements- pending an Implementing Act
Biofuels	Values are dependent on those provided by certified suppliers. See Chapter 4 on permitted production pathways and sustainability.	Default unless other values are certified by laboratory testing or direct emissions measurements – pending an Implementing Act	
RFNBOs / synthetic fuels			
On Shore Power Supply	Considered to be zero emission WtW[30]		

Source: Authors, based on Article 10 and Annex II of the FuelEU Maritime Regulation.

4.3.3 Global warming potential

It should be noted that the different TtW GHG emissions under FuelEU are aggregated by applying **Global Warming Potential (GWP) values assigned to N_2O and CH_4**. GWP refers to a metric to assess the ability of a GHG to trap heat in the atmosphere, relative to CO_2, which is assigned a GWP of 1. In a FuelEU context, GWP values are required to be used in conjunction with the combusted fuel TtW emission factors for these GHGs as per the following formula, which has been discussed in Section 3.2.[31]

$$CO_{2eq,TtWi,j} = (C_{fCO_{2,j}} \times GWP_{CO_2} + C_{fCH_{4,j}} \times GWP_{CH_4} + C_{fN_2O_j} \times GWP_{N_2O})_i$$

Examples of using the GWP to calculate the CH_4 and N_2O TtW emissions of fuel are given in Tables 4.3 and 4.4 (see steps 3 and 4 of the tables).

GWP values must also be used to calculate the TtW GHG emissions of slipped emissions (where applicable – see header on slipped emissions in Section 4.3.1) as per the following formula:

$$CO_{2eq,TtW,slip,i,j} = (C_{sfCO_{2,j}} \times GWP_{CO_2} + C_{sfCH_{4,j}} \times GWP_{CH_4} + C_{sfN_2O_j} \times GWP_{N_2O})_i$$

Where Csf CO_2, and Csf N_2O = 0. CsfCH_4 = 1

At present, the GWP values used for FuelEU stem from Directive (EU) 2018/2001, paragraph 4 of Part C of (as stated in Annex I of the FuelEU Maritime Regulation), which are as follows:

30 However, according to recital 44, the Commission should envisage the possibility to take into account the actual GHG emissions related to the electricity delivered through OPS at a later stage.

31 The GWP formula applies only to TtW emissions. For WtT emissions, the GWP calculations will follow the provisions foreseen in the specific scope of the certification of those fuels under RED framework or Gas and Hydrogen Directive.

Table 4.6 Global warming potential over 100 years, according to Directive (EU) 2018/2001, paragraph 4 of Part C of Annex V

GHG	GWP_{100}
CO_2	1
N_2O	298
CH_4	25

Guidance on GWP values can be found in the EU MRV/ETS guidance documents (specifically Section 4.4 of Guidance Document no. 1 – General guidance for shipping companies: the EU ETS and MRV Maritime). Note, however, that the GWP values for N_2O and CH_4 may differ under the MRV and ETS for shipping, since the MRV regulation refers to a different source for the GWP values (Commission Delegated Regulation (EU) 2020/1044).[32]

Shipping companies should be aware that **GWP values applied under the FuelEU Maritime Regulation may be subject to change**, for instance via amendments to the Annex of Directive (EU) 2018/2001, which FuelEU refers to. Any changes to GWP values would directly impact calculations of the GHG intensity of the energy used onboard under the FuelEU Maritime Regulation.

4.3.4 Fossil fuels

Ships subject to the FuelEU Maritime Regulation are **still permitted to use conventional fossil fuels for sailing and (for most ships) at berth**. Annex II of the FuelEU Maritime Regulation lists the following types of fuel under the class 'fossil', but in principle, any fuels can be used by ships where permitted by other maritime conventions:[33]

- HFO
- LFO
- MDO/MGO
- LNG
- LPG
- H2 (Natural Gas)
- NH3 (Natural Gas)
- Methanol (Natural Gas)

However, the use of conventional fossil fuels alone in a given reporting period will – in most cases – result in a WtW GHG intensity that exceeds the GHG intensity limit starting from 2025 (which is 89.34 gCO_2eq/MJ). This is true for the conventional fossil fuels HFO, LFO, MDO, and MGO based on the default values provided in Annex II. The use of LNG may still allow for compliance during the first years of the Regulation's application, depending on the energy system used and the type and amount of pilot fuel.

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32 Currently Commission Delegated Regulation (EU) 2020/1044 has the GWP from IPCC AR5 while RED Annex V contains the GWP from IPCC AR4.

33 For example, Ethane is not included in the list of fuels in Annex II of the FuelEU Maritime Regulation. Details on the use of Ethane can be found in Section 1.2 of ESSF WS1 – Report On calculation methodologies under Regulation (EU) 2023/1805.

Table 4.7 provides a list of fossil fuels for which complete emission factors are provided in Annex II of the Regulation, enabling their WtW GHG intensity to be determined. Unless otherwise indicated, the underlying calculations for how these WtW values are reached are described in Annex I of this guidance document. For certain other fossil fuels, some TtW emission factors are given as 'TBM' Annex II, so these fuels are listed separately in Table 4.8.

Table 4.7 Fossil fuels identified in Annex II of the Regulation and their WtW GHG intensity[34]

Fuel class: fossil		
Fuel type		**GHG intensity using the default WtT and TtW values provided in Annex II (gCO_2eq/MJ)**
HFO - ISO 8217 Grades RME to RMK		91.74
LFO - ISO 8217 Grades RMA to RMD		91.39
MDO & MGO - ISO 8217 Grades DMX to DMB		90.77 (See the steps for how this is calculated in Table 4.3)
LNG	LNG Otto (dual fuel medium speed)	89.20
	LNG Otto (dual fuel slow speed)	82.87
	LNG Diesel (dual fuel slow speed)	76.08 (See the steps for how this is calculated in Table 4.4)
	Lean burn spark-ignited engines (LBSI)	86.94

Source: authors, based on Annex II of the FuelEU Maritime Regulation

Table 4.8 provides a list of other fossil fuels and their WtW GHG intensity. Note that for these fuels, certain TtW values in FuelEU are listed as 'TBM.' For calculating the WtW emission factor for these fuels, the highest default value of the fuel class has been used (as stated in paragraph 3 of Annex II FuelEU), being 0.00005-gram CH_4 per gram fuel and 0.00018-gram N_2O per gram fuel. The underlying calculations to determine the WtW GHG intensity of these fuels are provided in Annex I of this guidance document.

[34] Note: Table 4.7 is aligned with Annex II of the FuelEU Maritime Regulation however in the Section 8.3.1.6 in the EU ETS and MRV Maritime General guidance for shipping companies.

Table 4.8 Fossil fuels identified in Annex II of the Regulation and their WtW GHG intensity

Fuel class: fossil		
Fuel type		**GHG intensity (using the default WtT and TtW values provided in Annex II) (gCO_2eq/MJ)**
LPG		74.86 (butane) 74.21 (propane) Note: columns 7 and 8 list 'TBM' for the TtW emission factor of CH4 and N2O.
Hydrogen H_2 (pathway: natural gas)	Fuel cells	132.00
	Internal Combustion Engine	132.45 Note: Column 8 lists 'TBM' for the TtW emission factor for N2O.
Ammonia NH_3 (pathway: natural gas)		123.95 Note: Column 7 lists N/A for the TtW emission factor for CH_4, and column 8 lists 'TBM' for the TtW emission factor for N_2O.
Methanol (pathway: natural gas)		103.15 Note: Columns 7 and 8 list 'TBM' for the TtW emission factor for CH_4 and N_2O.

Source: Authors based on FuelEU Maritime Regulation Annex II

4.3.5 Biofuels

The FuelEU Maritime Regulation **defines biofuels and biogas as liquid/gaseous fuel for transport produced from biomass** (relying on the definition from the RED). In Annex II of the FuelEU Maritime Regulation, the following types of fuel are listed under the class 'biofuels'; however, in practice, there are many production pathways of biofuels/biogas that may be considered:

- Ethanol
- Biodiesel
- Hydrotreated Vegetable Oil (HVO)
- Liquefied Bio-methane as transport fuel (Bio-LNG)
- Bio-methanol
- 'Other production pathways'
- Bio-H2

A starting point for biofuels by shipping companies for compliance towards the FuelEU Maritime Regulation should be the guidance applicable for the EU ETS Directive, which is available in the EU MRV/ETS guidance documents (specifically Chapter 9 of Guidance Document no. 1 **–** General guidance for shipping companies: the EU ETS and MRV Maritime). Guidance on the fuel certification procedure and carbon accounting for biofuels can also be found within ESSF WS1 - Report on Marine Fuels Certification Procedures to support the implementation of Fuel EU Maritime**.**

The following are important considerations concerning the sustainability and GHG savings criteria that should be demonstrated for biofuels used by a ship in scope of FuelEU. If adherence to the given criteria cannot be demonstrated, the fuel will be considered to have the same emission factors as the least favourable fossil fuel pathway for that type of fuel (MDO, LNG, LPG, H_2, NH_3 or methanol).

- **The biofuel should meet the sustainability criteria** established in the EU RED (the same requirements apply for fuels that intend to be 'zero rated' for the EU ETS – i.e. RED Article 29).

'Food and feed crops' - However, on top of that, the FuelEU Maritime Regulation specifically states that biofuels produced from food and feed crops shall be considered to have the same emission factors as the least favourable fossil fuel pathway for that type of fuel (MDO, LNG, LPG, H_2, NH_3 or methanol). 'Food and feed crops' are defined (in Article 2 of the RED) as *starch-rich crops, sugar crops or oil crops produced on agricultural land as a main crop, excluding residues, waste or ligno-cellulosic material and intermediate crops, such as catch crops and cover crops, provided that the use of such intermediate crops does not trigger demand for additional land.*

As such, shipping companies should ensure that the documentation from the fuel supplier clearly states the feedstock of the biofuel (see also Chapter 5, which covers fuel documentation in more detail).

- **The biofuel should result in a GHG saving of 50-65% compared to the fossil fuel pathway** for the given fuel type (Article 10(1) of the FuelEU Maritime Regulation). The fossil fuel comparator defined in Commission Implementing Regulation 2023/1185 in regard to the RED is 94 gCO_2eq/MJ. In practice, this means that biofuels must have a GHG intensity of 47-32.9 gCO_2eq/MJ or lower.

- **Proof** of the above GHG emission intensity and the sustainability characteristics of fuels **should be demonstrated** by alignment to a certification scheme recognised by the Commission (see Chapter 5).

- **Blending:** Annex I of the Regulation states that where there is product blending, information required by this Regulation shall be given for each product. This means that where biofuels are blended with fossil fuels, companies need to ensure they have documentation for both fuel types as separate neat fuels – so including the LCV [MJ/g] and all required information to calculate the WtT emissions of the fuel (see section below).

Separate documentation for blended fuels - It may not be standard practice today to receive separate documentation for the components of blended fuels. This, therefore, needs attention, as it will be important during the verification of a ship's FuelEU report**. In the absence of the relevant separate documentation for each blend fraction (neat fuels), the blend fuel shall be attributed the default emissions factor values of the least favourable fossil fuel type.**

Determining WtW GHG intensity of biofuels

For RED certified liquid and gaseous biofuels, the WtT GHG emission intensity *(CO_2eq WtT)* is to be calculated as indicated in column 4 of the table in Annex II of the FuelEU Maritime Regulation, as follows:

$$WtT\ CO_2eq\ = E\ - \frac{C_f CO_2}{LCV}$$

where E = Total GHG emission intensity (gCO_2eq/MJ) from the supply and use of the fuel, as per documentation about the fuel provided by the fuel supplier (normally a Proof of Sustainability document – further explained in Chapter 5). The deduction is intended to offset the biogenic CO_2 combustion emissions and avoid double-counting of emissions.

For the LCV, the main reference in the FuelEU Annex II table is the default LCV values in RED Annex III. When biofuel production pathways do not have default LCVs as per legal reference, the LCV or information to derive the LCV from the POS/POC provided by the fuel supplier should be based on a lab analysis.

Example E and LCV values for biofuels

As can be read above, the GHG intensity of biofuels depends on various factors such as the E value and LCV of the fuel. An example of how these can be used in practice is given below.

In Table 4.9, example E values for different kinds of biofuels are listed using the default values given in RED Annex V & VI. The same table also lists example LCV values using default LCV values in RED Annex III (converted to MJ/g). This table is presented below just to indicate how the WtW value is derived for biofuels: if the actual E value from fuel documentation (in principle, the 'Proof of Sustainability' document) differs from the default value, the value from the PoS should be used to calculate the actual WtT emission intensity of the biofuel pathway. Similarly, when biofuel production pathways do not have default LCVs, the LCV stated on or derived from information contained in the PoS or other similar documentation (see Chapter 5.3) should be used. Note that FuelEU Annex II does not provide TtW emission factors for all biofuels (indicated by the term TBM). In the table, default TtW emission factors have thus been given based on the highest default value of the fuel class in the same column, being 0.00005-gram CH_4 per gram fuel and 0.00018-gram N_2O per gram fuel.

Table 4.9 Relevant biofuel parameter values including FuelEU Annex II values[35]

Annex II Column	2 / 5	3		4	6	7	8	9
			E	WtT	TtW			
Pathway name / Consumer		**LCV** [MJ/g]	Example E values per RED Annex V & VI [gCO_2eq/MJ]	$CO_{2eq\ WtT}$ [gCO_2eq/MJ]	$C_{f\ CO2}$ [$gCO_2/gFuel$]	$C_{f\ CH4}$ [$gCH_4/gFuel$]	$C_{f\ N2O}$ [$gN_2O/gFuel$]	C_{slip} [%]
Bioethanol (wheat straw)[36]		0.027	15.70	-55.15185	1.913	**0.00005**	**0.00018**	0.0%
Biodiesel (waste cooking oil)[37]		0.037	14.90	-61.69459	2.834	**0.00005**	**0.00018**	0.0%
Hydrotreated Vegetable Oil (waste cooking oil)[38]		0.044	16.00	-54.79545	3.115	0.00005	0.00018	0.0%
Liquefied Biomethane (bio-waste) / Otto (dual fuel medium speed)[39]		0.050	19.17	-35.83000	2.750	0.00000	0.00011	3.1%
Liquefied Biomethane / Otto (dual fuel slow speed)		0.050	19.17	-35.83000	2.750	0.00000	0.00011	1.7%
Liquefied Biomethane / Diesel (dual fuels)		0.050	19.17	-35.83000	2.750	0.00000	0.00011	0.2%
Liquefied Biomethane / LBSI		0.050	19.17	-35.83000	2.750	0.00000	0.00011	2.6%
Bio-methanol		0.020	10.40	-58.35000	1.375	**0.00005**	**0.00018**	0.0%
Other Production Pathways		0.037	15.00[40]	-69.18919	3.115	0.00005	0.00018	0.0%

Source: ESSF WS1 – Report On calculation methodologies under Regulation (EU) 2023/1805

35 The numbers in bold are default values for $CH_{4\ and}\ N_2O$, representing the highest default values for the fuel class in the same column, since the value is given as 'TBM' in Annex II of FuelEU.

36 Default E value for bioethanol from wheat straw feedstock from RED is used here as an example. For other bio-ethanol feedstock default values see RED Annex V E.

37 Default E value for biodiesel from waste cooking oil feedstock from RED is used here as an example. For other bio-diesel feedstock default values see RED Annex V D.

38 Default E value for HVO from waste cooking oil feedstock from RED is used here as an example. For other HVO feedstock default values see RED Annex V D.

39 Default E value for bio-methane from bio-waste feedstock from RED is used here as an example. For other bio-methane feedstock default values see RED Annex VI D. See also the text note on biomethane E values.

40 Illustrative example E value is used here. Default E-values for other production pathways as per specified feedstocks as per RED Annex V, VI.

To take the example of bio-ethanol (wheat straw – see orange box in table above), an E value of 15.70 gCO_2eq/MJ and an LCV of 0.027 MJ/g can be seen in Table 4.9. These values are then used to calculate the CO_2eqWtT emissions as per the formula given in column 4 of FuelEU Annex II:

$$CO_2eqWtT = E - \frac{C_f CO_2}{LCV} = 15.7 - \frac{1.913}{0.027} = -55.15185 \text{ g } CO_2eq/MJ.$$

The negative WtT result arises because the biogenic CO_2 absorbed from the atmosphere by the biomass during its growth is subtracted from E in the calculation.

Applying the WtT GHG intensity formula, accordingly, using 1 metric tonne for simplicity:

$$WtT = \frac{\sum_i^{n\,fuel} M_i \times CO_{2eq\,WtT,i} \times LCV_i}{\sum_i^{n\,fuel} M_i \times LCV_i + \sum_k^c E_k} = \frac{1 \times -55.15185 \times 0.027}{1 \times 0.027 \times 1 + 0} = -55.15185 \text{ g } CO_2eq/MJ$$

Similarly, the TtW emission intensity of consumed bioethanol is calculated as:

$$TtW = \frac{\sum_i^{n\,fuel} \sum_j^{m\,engine} M_{i,j} \times \left[\left(1 - \frac{1}{100} C_{slip\,j}\right) \times \left(CO_{2eq,TtW,i,j}\right) + \left(\frac{1}{100} C_{slip\,j} \times CO_{2eq\,TtW,slip,i,j}\right)\right]}{\sum_i^{n\,fuel} M_i \times LCV_i + \sum_k^c E_k} =$$

$$\frac{1_{i,j} \times \left[(1) \times \left(C_{fCO_{2,j}} \times GWP_{CO_2} + C_{fCH_{4,j}} \times GWP_{CH_4} + C_{fN_2O_j} \times GWP_{N_2O}\right) + (0)\right]}{1 \times 0{,}02700 + 0} =$$

$$\frac{1_{i,j} \times [(1) \times (1.913 + 0.00005 \times 25 + 0.00018 \times 298) + (0)]}{1 \times 0.027 + 0} = 72.88481 \text{ g } CO_2eq/MJ.$$

The total WtW emission intensity of bioethanol is the sum of the calculated WtT and TtW emission intensities:

$$WtW\ CO_2eq = -55.15185\ gCO_2eq/MJ + 72.88481\ g\ CO_2eq/MJ = 17.73296 \text{ g } CO_2eq/MJ.$$

Applying the applicable GHG intensity formula from FuelEU Annex I in the same manner, and including the values from Table 4.10, the resulting WtW GHG intensities for various biofuel types/pathways are shown in Table 4.10. It must be remembered that these values are based on example E and LCV values, which may not accurately reflect the properties and production pathway of the given bunkered fuel – as such, E and LCV values stated in the fuel documentation take precedence and will be subject to review during the FuelEU verification period.

Table 4.10 FuelEU biofuel WtW GHG intensities

Pathway / Consumer]	WtT CO_2eq [gCO_2eq/MJ]	TtW CO_2eq [gCO_2eq/MJ]	WtW CO_2eq [gCO_2eq/MJ
Bioethanol (wheat straw)	-55.15185	72.88481	17.73296
Biodiesel (waste cooking oil)	-61.69459	78.07811	16.38351
Hydrotreated Vegetable Oil (waste cooking oil)	-54.79545	72.04295	17.24750
Liquefied Biomethane / Otto (dual fuel medium speed)	-35.83000	69.43028	33.60028
Liquefied Biomethane / Otto (dual fuel slow speed)	-35.83000	63.20945	27.37945
Liquefied Biomethane / Diesel (dual fuels)	-35.83000	56.54429	20.71429
Liquefied Biomethane / LBSI	-35.83000	67.20855	31.37855
Bio-methanol	-58.35000	71.49450	13.14450
Other Production Pathways	-69.18919	85.67270	16.48351

Source: ESSF WS1 – Report on calculation methodologies under Regulation (EU) 2023/1805

4.3.6 Renewable Fuels of Non-Biological Origin

RFNBO Definition - The definition of RFNBOs used under the FuelEU Maritime Regulation (relying on the EU RED) is: '*liquid and gaseous fuels, the energy content of which is derived from renewable sources other than biomass.'*

Annex II of the FuelEU Maritime Regulation provides the following types of fuel under the class 'Renewable Fuels of Non-Biological Origin (RFNBO):

- e-diesel
- e-methanol
- e-LNG
- e-H2
- e-NH3
- e-LPG
- e-DME

The following are important considerations concerning the sustainability and GHG savings criteria that should be demonstrated for RFNBOs. If adherence to these criteria cannot be demonstrated, the fuel will be considered to have the same emission factors as the least favourable fossil fuel pathway for that type of fuel.

- **RFNBOs must result in a GHG saving of at least 70%:**
  - In practice, this means that RFNBOs must have a GHG intensity of 28.2 gCO_2eq/MJ or lower. This is 30% of 94 gCO_2eq/MJ, which is the fossil fuel comparator defined in Commission Implementing Regulation 2023/1185 in regard to the RED.
- **Default TtW emission factors are provided** in Annex II of the FuelEU Maritime Regulation. Pending secondary legislation, shipping companies may apply actual TtW

emission factors provided they are certified by means of laboratory testing or direct emissions monitoring.

- For RFNBOs, the FuelEU WtT emissions *(CO_2eq_{WtT})* in column 4 of the table in FuelEU Annex II says, '*Ref. To Directive (EU) 2018/2001* (the RED). The meaning of this reference is explained below.

Determining WtW GHG intensity of RFNBOs

For RFNBOs, the FuelEU WtT emissions *(CO_2eq_{WtT})* are calculated as: $CO_2eq_{WtT} = E - e_u$, where *E* = Total GHG emission intensity (g CO_2eq/MJ) from the supply and use of the fuel, as per the Proof of Sustainability (PoS) or other documentation (see Chapter 4) of the certified biofuel. The e_u value is the emissions from the combusted fuel in use, as per the PoS/PoC.

Table 4.11 provides an indicative e_u values for different kinds of RFNBOs using standard values provided in secondary legislation to the RED (Delegated Regulation (EU) 2023/1185). Note that if the actual e_u value from the PoS/PoC differs from the assumed and standard values, the values from the PoS/PoC should be used to calculate the actual WtT emission intensity of the RFNBO pathway.[41]

To give an example: if it is assumed that for e-diesel an E value of 10.00 gCO_2eq/MJ is applied, as well as an e_u value of 73.20 gCO_2eq/MJ then the FuelEU WtT emissions *(CO_2eq_{WtT})* can be calculated as follows:

$$CO_2eq_{WtT} = E - e_u = 10.00 - 73.20 = \text{-}63.20 \text{ g } CO_2\text{eq/MJ}.$$

The example above does however not yet consider a reward factor applicable to the use of RFNBOs.

[41] The meaning of a Proof of Sustainability (PoS) and Proof of Compliance (PoC) document is further elaborated in Chapter 5.3.2.

Table 4.11 Relevant RFNBOs / e-fuels parameter values including FuelEU Annex II values[42]

Annex II Column	2/5	3			4	6	7	8	9
			E	e_u	WtT	TtW			
Pathway name / Consumer		LCV [MJ/g]	As per PoS/PoC [gCO_2eq/MJ]	Based on 'standard values' ([43]) [gCO_2eq/MJ]	$CO_{2eq\ WtT}$ [gCO_2eq/MJ]	$C_{f\ CO2}$ [$gCO_2/gFuel$]	$C_{f\ CH4}$ [$gCH_4/gFuel$]	$C_{f\ N2O}$ [$gN_2O/gFuel$]	C_{slip} [%]
e-diesel		0.0427	See PoS/PoC	73.2	-63.2	3.206	0.00005	0.00018	0.0%
e-methanol		0.0199	See PoS/PoC	68.9	-58.9	1.375	**0.00005**	**0.00018**	0.0%
e-LNG / Otto (dual fuel medium speed)		0.0491	See PoS/PoC	56.2	-46.2	2.750	0.00000	0.00011	3.1%
e-LNG / Otto (dual fuel slow speed)		0.0491	See PoS/PoC	56.2	-46.2	2.750	0.00000	0.00011	1.7%
e-LNG / Diesel (dual fuel slow speed)		0.0491	See PoS/PoC	56.2	-46.2	2.750	0.00000	0.00011	0.2%
e-LNG / LBSI		0.0491	See PoS/PoC	56.2	-46.2	2.750	0.00000	0.00011	2.6%
e-H2 / Fuel Cells		0.1200	See PoS/PoC	0.0	10.0	0.000	0.00000	0.00000	0.0%
e-H2 / ICE		0.1200	See PoS/PoC	0.0	10.0	0.000	0.00000	**0.00018**	0.0%
e-NH3 / Fuel Cells		0.0186	See PoS/PoC	0.0	10.0	0.000	**0.00005**	**0.00018**	0.0%
e-NH3 / ICE		0.0186	See PoS/PoC	0.0	10.0	0.000	**0.00005**	**0.00018**	0.0%

Source: ESSF WS1 – Report on calculation methodologies under Regulation (EU) 2023/1805

[42] The numbers in bold are default values for CH_4 and N_2O, representing the highest default values for the fuel class in the same column, since the value is given as 'TBM' in Annex II of FuelEU.

[43] 'Standard values' for greenhouse gas emission intensities of elastic inputs according to Annex B. of Commission Delegated Regulation (EU) 2023/1185.

Reward factor for the use of RFNBOs

Owing to their potential for decarbonisation of the energy used in shipping, the use of RFNBOs is subject to a special framework under Article 5 of the FuelEU Maritime Regulation, designed to support the early uptake of these fuels in the marine bunker fuel mix.

Shipping companies that use RFNBOs meeting the criteria set out at the start of Section 4.3.6 **can take advantage of a reward factor in the Regulation**.

The reward factor means that for every batch of RFNBO a ship consumes within the scope of the Regulation, the energy counts as double, while the counted emissions remain the same. In practice, the WtW emission factor is halved. The reward factor can be applied from 01 January 2025 to 31 December 2033.

The following example presents the WtW GHG intensity of e-diesel when the RFNBO reward is applied (completing the example above with an assumed E value of 10.00 gCO_2eq/MJ and an e_u value of 73.20 gCO_2eq/MJ). For simplicity, consumption of 1 metric tonne is used in the example.

$$WtT = \frac{\sum_i^{n\,fuel} M_i \times CO_{2eq\,WtT,i} \times LCV_i}{\sum_i^{n\,fuel} M_i \times LCV_i \times RWD_i + \sum_k^c E_k} = \frac{1 \times -63.20 \times 0.0427}{1 \times 0.0427 \times 2 + 0} = \text{-31.60 g } CO_2eq/MJ$$

Similarly, the RFNBO reward factor is also part of the TtW emission intensity formula, which gives a TtW emission intensity of consumed e-diesel as:

$$TtW = \frac{\sum_i^{n\,fuel} \sum_j^{m\,engine} M_{i,j} \times \left[\left(1-\frac{1}{100}C_{slip\,j}\right)\times\left(CO_{2eq,TtW,i,j}\right)+\left(\frac{1}{100}C_{slip\,j}\times CO_{2eq\,TtW,slip,i,j}\right)\right]}{\sum_i^{n\,fuel} M_i \times LCV_i \times RWD_i + \sum_k^c E_k} =$$

$$\frac{1_{i,j} \times \left[(1)\times\left(C_{fCO_{2,j}}\times GWP_{CO_2}+C_{fCH_{4,j}}\times GWP_{CH_4}+C_{fN_2O_j}\times GWP_{N_2O}\right)+(0)\right]}{1 \times 0{,}0427 \times 2 + 0} =$$

$$\frac{1_{i,j} \times [(1)\times(3.206+0.00005\times25+0.00018\times298)+(0)]}{1 \times 0.0427 \times 2 + 0} = 38.18372 \text{ g } CO_2eq/MJ.$$

The total WtW emission intensity of e-diesel is the sum of the calculated WtT and TtW emission intensities:

$$WtW\ GHG\ intensity = -31.60\ gCO_2eq/MJ + 38.18372\ gCO_2eq/MJ = 6.58372 \text{ g } CO_2eq/MJ$$

Possible RFNBO sub-target for all ships

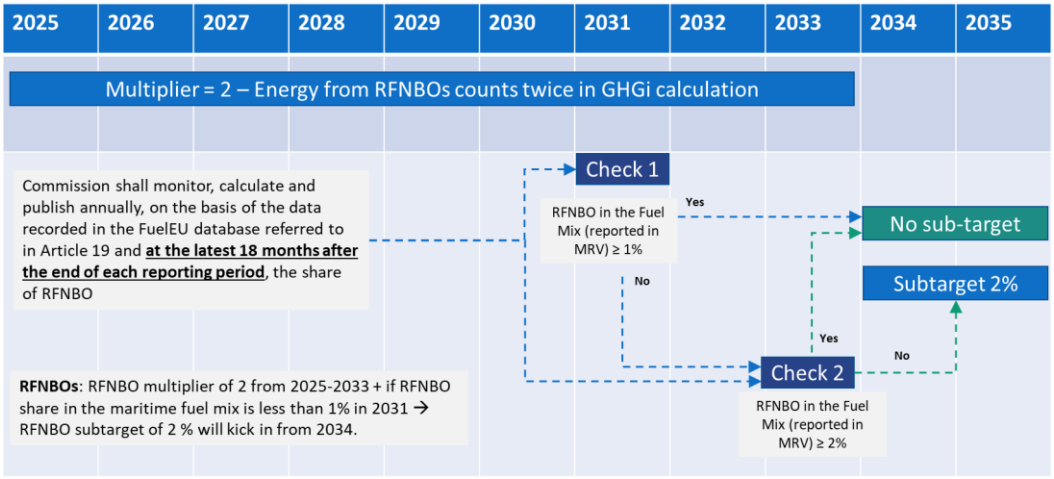
The Regulation requires the Commission to monitor and annually publish the share of RFNBOs in the total annual energy used by ships subject to the Regulation. If the share of RFNBOs used in 2031 is less than 1%, this may trigger a stricter requirement in the Regulation, which requires all ships to derive 2% of their energy use from RFNBOs starting in 2034 (the RFNBO sub target).

The following criteria regarding this possible sub-target are embedded in the Regulation as presented in Figure 4.2:

1. The sub-target will not apply if the Commission's monitoring of the use of RFNBOs demonstrates before 2033 that the share of RFNBOs is already greater than 2%.

2. The sub-target for RFNBO will not apply if there is evidence, following a Commission assessment, of insufficient production capacity and availability of RFNBOs, uneven geographical distribution, or too high a price of those fuels.[44]

Figure 4.2 Criteria for possible RFNBO sub-target



Source: European Commission (EC), DG MOVE

In the case it is determined that the reward factor will apply beyond 2034, the Commission is required to adopt additional implementing acts specifying the rules that will be applicable as regards:

- Verification and calculations of GHG intensity
- Applicable flexibility mechanisms
- Applicable FuelEU penalties

Note also that the sub-target of 2% RFNBO does not need to apply to ships that demonstrate the same share of energy is met by other fuels/energy that provide equivalent GHG savings and are certified in accordance with the Regulation's Article 10. Note, however, that the use of biofuels referred to in Part B of Annex IX to Directive (EU) 2018/2001 will not be considered equivalent to GHG savings. Today, this applies to biofuels from Used Cooking Oil and Animal fats classified as categories 1 and 2 in accordance with Regulation (EC) No 1069/2009.

The combination of measures to support RFNBO (on the one hand, a reward factor and on the other, a potential sub-target) aims at creating investment opportunities for ship operators and fuel suppliers. Note, however, that the present reward factor for RFNBOs is applicable only until the end of 2033, so if the sub-target for RFNBOs goes ahead from 2034 onwards, there will be no co-existing incentives.

4.3.7 Other types of fuels

Besides biofuels and RFNBOs, FuelEU also recognises the following certified fuels towards meeting GHG intensity limits:

[44] Other reasons for not establishing the sub-target may also apply based on delegated acts the Commission is empowered to enact, subject to Article 28 of the FuelEU Maritime Regulation.

- **Recycled Carbon Fuels (RCF)**: Specific type of low-carbon fuels produced from liquid or solid waste streams of non-renewable origin that are not suitable for material recovery in accordance with Article 4 of Directive 2008/98/EC (Waste Framework Directive), or from waste processing gas and exhaust gas of non-renewable origin which are produced as an unavoidable and unintentional consequence of industrial production process, following the definition in Article 2 of Directive (EU) 2018/2001 (RED). An example could be methanol produced from a solid non-renewable waste stream that is unsuitable for material recovery.[45]

- **Low Carbon Fuels (LCF)**: Recycled carbon fuels (see above definition), low-carbon hydrogen and synthetic gaseous and liquid fuels the energy content of which is derived from low-carbon hydrogen, that meet the GHG emission reduction threshold of 70% compared to the fossil fuel comparator for RFNBO set out in the methodology adopted pursuant to Article 29a(3) of Directive (EU) 2018/2001 (RED)

The sustainability and GHG reduction requirements for RCFs are the same as those for RFNBOs. However, the reward factor for RFNBOs does not apply to LCF. The requirements for LCFs were recently adopted.[46]

4.4 Prioritised allocation of lower GHG intensity fuels

The FuelEU Maritime Regulation does not specify a particular methodology for how fuels used by a ship during a reporting year should be allocated towards the energy consumed by the ship within the scope of the Regulation. Therefore, in the absence of a defined methodology in the legislative text,[47] fuels used on different types of voyages or port calls can be freely allocated to meet the total energy scope within one calendar year, provided they have been reported under the MRV Regulation.

As such, while the scope of the FuelEU Maritime Regulation covers only 50% of the energy used by a ship on voyages partially within the jurisdiction of EU/EEA States, the full amount of energy obtained from lower GHG intensity fuels used on such voyages may be allocated to the ship's total energy consumed under the scope of the FuelEU Maritime Regulation. This has the effect of reducing the ship's annual GHG intensity. In fact, energy from lower GHG intensity fuels on voyages that are otherwise exempted from FuelEU under Articles 2(1c), 2(3), 2(4), 2(5), and 2(6) may also be freely allocated, provided the fuel was reported under the MRV regulation. Similarly, sources of energy other than traditional fuels (such as electricity) can also be allocated to the FuelEU energy scope. Electricity may form part of the energy used on voyages partially within the jurisdiction of an EU/EEA State in the case of use of OPS during an intermediate stop forming part of a FuelEU/MRV voyage, or in the case of hybrid or other innovative propulsion systems. All of this is fitting with the spirit of the Regulation, which is to promote the uptake and use of renewable and low-carbon fuels. Lastly,

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45 See Section 3.5.1 of ESSF WS1 – Report On calculation methodologies under Regulation (EU) 2023/1805

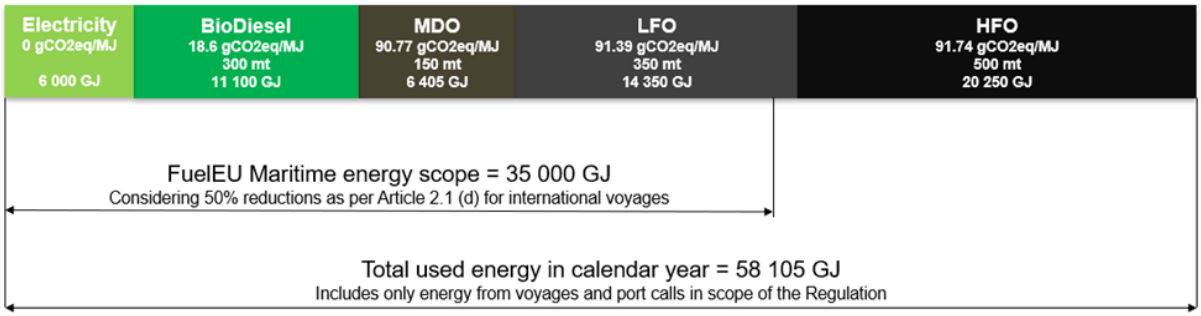
46 For more information, see the Delegated Regulation.

47 Article 2 of FuelEU specifies the scope of the Regulation in terms of the energy used by ships but makes no mention of fuels used. Also Annex I am detailing the methodology for establishing the GHG intensity of the energy used onboard by the ship does not detail exactly how fuels used by the ship throughout the reporting period should be allocated. It is however clear from Annex I that the methodology applies to 'fuel types delivered to the ship in the reporting period' (which is further defined in Article 3(41) as being from 1 January – 31 December.

in cases where the ship is eligible for a deduction in mass fuel used due to sailing in ice or the ship's ice class (see Section 4.6.1), it is possible to allocate this deduction to the fuels with the highest GHG intensity.

Prioritising the allocation of fuels in this way can support shipping companies to maximise the benefit of their use of lower GHG intensity fuels/energy during a reporting year. Figure 4.3 provides an example of prioritised allocation of fuel for a ship during a reporting period. In the assumed scenario, the ship performed several voyages for which only 50% of the energy is in scope of the FuelEU Maritime Regulation. Of the total 58,105 GJ energy consumed by the ship on voyages and port calls in scope of the Regulation, 35,000 GJ of the energy is assumed to be in scope of Article 2. Considering the fuel mix, which includes energy from OPS, certified biodiesel, MDO, LFO and HFO, the most favourable fuels are used first in the calculation of GHG intensity. This increases the impact of using low-GHG-intensity energy sources on the compliance balance, effectively incentivising the introduction of such energy sources into the energy mix up to the amount of energy in scope of FuelEU. It must, however, be noted that prioritised allocation of fuel/energy in this way is not strictly imposed by the Regulation: shipping companies which do not wish their annual average GHG intensity to be calculated in this way should clearly communicate that with their verifier

Figure 4.3 Illustration of fuel mix for voyages/port of calls in the scope of FuelEU Maritime Regulation in the calendar year, and the most beneficial fuel allocation to FuelEU Article 2 energy scope



Source: ESSF WS1 – Report on calculation methodologies under Regulation (EU) 2023/1805

Lower GHG intensity fuels between on-EEA ports - Logically, the prioritised allocation of lower GHG intensity fuels only applies when such fuels are used on voyages to/from/between an EEA port (and reported under the MRV). Lower GHG intensity fuels used by ships on voyages between two non-EEA ports have no bearing on determining a ship's annual GHG intensity under FuelEU. Such voyages fall under neither the EU MRV nor the FuelEU Maritime Regulation.

4.5 Wind-assisted propulsion systems

FuelEU enables an opportunity to lower a ship's annual GHG intensity by installing wind-assisted propulsion systems (WAPS). This is achieved via a reward factor (f_{wind}) applied in the GHG intensity formula set out in Annex I of FuelEU (see also Section 4.2).

Wind-assisted propulsion is defined in Article 3(9) of FuelEU as: *'propulsion, whether partial or full, of a ship by wind energy harnessed by means of wind-assistance propulsion systems such as, inter alia, rotor sails, kites, hard or rigid sails, soft sails, suction wings, or turbines.'*

Ships with WAPS can achieve up to a 5% reduction in their annual GHG intensity. The level of reduction depends on the ratio between the effective wind power (P_{wind}) and the installed propulsion power of the ship (P_{prop}). The higher the nominal power of the installed WAPS compared to the total main engine propulsion power of the ship, the higher the WAPS reward factor (to a maximum of 5%).

The value P_{wind} is the available effective power of the WAPSs and corresponds to $f_{eff} * P_{eff}$, [48] as calculated in accordance with the 2021 guidance on the treatment of innovative energy efficiency technologies for the calculation and verification of the attained (EEDI) and (EEXI) MEPC.1/Circ.896.[49] In principle, these values should be found on the EEDI/EEXI technical file for ships with WAPS installed. Note that for ships not subject to the EEDI/EEXI (such as diesel electric ships), the value of P_{wind} must still be verified by a recognised body (such as a classification society) by following the guidance in MEPC.1/Circ.896. This is to ensure a standardised approach is followed to calculate P_{wind} for all ships with WAPS subject to the FuelEU.

- P_{Prop} is the propulsion power of the ship and corresponds to P_{ME} as defined in the 2018 guidelines on the method of calculation of the attained EEDI for new ships (IMO resolution MEPC.364(79)) and the 2021 guidelines on the method of calculation of the attained EEXI (IMO resolution MEPC.333(76)).
- Where shaft motor(s) are installed
- $P_{Prop} = P_{ME} + P_{PTI(i),shaft}$

The reward factors are based on the ratio between P_{wind} and P_{Prop} are as follows. Note that a ratio less than 0.05 does not create any reward factor.

Table 4.12 Reward factors based on the ratio between Pwind and P_Prop

Value of P_{wind} / P_{prop}	Reward factor
< 0.05	None
0.05 – 0.099	0.99 (meaning a 1% reduction in the ship's total GHG intensity)
0.1 - 0.149	0.97 (meaning a 3% reduction in the ship's total GHG intensity)
Equal to or greater than 0.15	0.95 (meaning a 5% reduction in the ship's total GHG intensity)

Source: Authors, based on FuelEU Maritime Regulation Annex I

[48] According to MEPC.1/Circ.896**,** (feff * Peff) is the available effective power in kW delivered by the specified wind assisted propulsion system. P_{eff} stands for effective power and f_{eff} stands for availability factor.

[49] EEXI evaluates the energy efficiency of existing ships to meet specific standards, while the EEDI assesses new ships' designs for compliance with IMO energy efficiency criteria. An overview and links to resolutions can be found here on the IMO website.

To take an example, a ship with a Pwind of 1,000 kW and a P_{Prop} of 19,780 kW would have a Pwind/Pprop ratio of 0.05 (1000 / 19780), which earns a reward factor of 0.99 (1%). This 1% reduction can be applied to the ship's annual GHG intensity.

Importantly, while the value Pwind is presently the nominal power of the installed WAPS and not the actual energy generated or saved by the use of the WAPS, this may change following a review of the Regulation, which is due by the end of 2027. In particular, Article 30(2)(h) states that the review should include the possibility to include (actual) energy provided by wind in the calculation of the ship's GHG intensity, subject to the availability of a verifiable method for monitoring and accounting of wind propulsion energy.

An example in Table 4.13 illustrates how the reward factor (f_{wind}) influences a ship's annual GHG intensity. It takes the example of a ship consuming only MGO as fuel without any use of OPS. The use of this fuel in a reporting year without a WAPS installed would result in a GHG intensity for the ship of 90.77 g CO_2eq/MJ, which is above the GHG intensity target for reporting year 2025. However, when a WAPS is installed with a Pwind/Pprop of 0.05, then the ship benefits from a 1% reduction of its annual GHG intensity. If a WAPS of higher nominal power were installed to reach a Pwind/Pprop of 0.15, the ship could end up with a GHG intensity of 86.23 g CO_2eq/MJ, which is well below the required target for the 2025 - 2029 period.

Table 4.13 Illustration of the contribution of WAPS to reducing a ship's annual GHG intensity

Item	Pwind/Pprop	Annual GHG intensity (g CO_2eq/MJ)
WtW GHG intensity MGO without WAPS reward	N/A	90.77
Annual GHG intensity, including wind reward factor of .99	0.05	0.99 x 90.77 = 89.86
Annual GHG intensity, including wind reward factor of .95	0.15	0.95 x 90.77 = 86.23

Source: Authors, based on the FuelEU Maritime Regulation

4.6 Adjusted mass of fuel for ice navigation

Annex IV of FuelEU, containing the formula for calculating a ship's compliance balance, provides that:

> *for any ship having the ice class IC, IB, IA or IA Super or an equivalent ice class, the company may request, until 31 December 2034, to exclude the additional energy consumption* ***due to sailing in ice conditions ('ice derogation 1')****. For any ship having the ice class IA or IA Super or an equivalent ice class, the company may request to exclude the additional energy consumption,* ***due to the technical characteristics of the ship*** **('ice derogation 2').**

These 'ice derogations,' reduce the mass of fuel that is applied when calculating a ship's actual GHG intensity (GHGIEactual) in Annex IV of the Regulation. This is the reason why the

derogations are discussed in this section of the guidance document. The adjusted mass of fuel for ice navigation also has an impact on a ship's compliance balance (discussed in Section 10.2) and potential FuelEU penalty (discussed in Section 12.1).

The first derogation possibility concerns an adjustment (lowering) of the mass amount of fuel used by the ship when navigating in ice (ice derogation 1). The premise is that ships navigating through ice consume more fuel than they would do when sailing in open water. This derogation may be used by ships having the ice class IC, IB, IA or IA Super or an equivalent ice class. An additional derogation (ice derogation 2) is awarded due to the technical characteristics of the ship if it has ice class IA or IA Super, or an equivalent ice class (in other words, the highest ice classes). The premise is that the technical design of the ship may put them at a disadvantage from an energy efficiency design perspective.

Ice Class - Information on the correspondence between different ice classes can be found in Annex II concerning the required information to be listed on a ship's FuelEU Monitoring Plan.

Ice derogation 1:

According to Annex V, the additional energy consumption of a ship having the ice class IC, IB, IA or IA Super or an equivalent ice class **due to sailing in ice conditions** is calculated as follows:

$$E_{additional\ due\ to\ ice\ conditions} = E_{ice\ condition} - E_{voyages,ice\ conditions,adjusted}$$

with

$$E_{voyages,ice\ conditions,adjusted} = \frac{E_{voyages,open\ water}}{D_{open\ water}} \times D_{ice\ condition}$$

This additional energy consumption due to ice conditions is subsequently converted into the mass to be considered for the derogation.

The additional energy consumption due to ice conditions is calculated by determining the difference between the actual energy consumption in ice conditions and the energy consumption that a ship would have used if it had sailed the same distance in open water instead of in ice conditions. To this end, the average energy consumption per nautical mile on voyages in open water is applied to the distance sailed in ice conditions.

For ice derogation 1, a limit holds: A ship's additional energy consumption due to ice conditions cannot be more than 1.3 times the ship's energy consumption in open water.

Ice derogation 2:

Meanwhile, the additional energy consumption **due to the technical characteristics** of a ship having the ice class IA or IA Super or an equivalent ice class is calculated as follows:

$$E_{additional\ due\ to\ ice\ class} = 5\% \times (E_{voyages,total} - E_{additional\ due\ to\ ice\ conditions})$$

The additional energy consumption due to ice class is subsequently converted into the mass to be considered for the derogation.

This means that, regarding derogation 2, it is assumed that 5% of the energy consumption in open water operation of ships can be attributed to the different, ice class-related design of ships having the ice class IA or IA Super or an equivalent ice class and is therefore considered as additional. A ship which can take advantage of ice derogation 2 can also take advantage of ice derogation 1 if it has effectively sailed through ice during the reporting year.

Ice derogation 1 is valid only until the end of 2034 (but with the possibility for extension subject to review). Ice derogation 2 does not have an end-date (but may be subject to a review as per Article 30 of the Regulation).

An example is given in the next section, applying both derogations to a ship with ice class IA super. The example comes from the important work found in ESSF WS1 – Report on calculation methodologies under Regulation (EU) 2023/1805 and will be presented in a simplified calculation.

4.6.1 Ice class adjusted mass of fuel calculation example

In this section, a calculation example is provided for a ship with ice class IA Super undertaking a 2-day voyage of 600 nautical miles, with 75 nautical miles navigated under ice conditions. It is assumed that the ship consumes 7.5 tonnes of LFO (ISO 8217 Grades RMA to RMD) while navigating in ice, out of a total voyage consumption of 51.25 tonnes of LFO in both ice and open-water conditions. These fuel consumption amounts and distances are assumed to be entirely within the scope of the Regulation. Even though this example addresses only one voyage, the exemption should be applied to annual voyage data, as explained in Annex V of the FuelEU Maritime Regulation.

Table 4.14 shows a breakdown of the relevant numbers needed for the calculation to adjust the mass of fuel, showing in column 1 the notation as it is referred to in Annex V of FuelEU. Although the notation from Annex V is used throughout, the calculations are presented in a different order than in Annex V for simplicity of understanding. In this document, the formulas are presented in the order required for calculating the results.

Table 4.14 Breakdown of the relevant values needed for the ice class calculation example

Notation in Annex V	Description	Value
D_{total}	Total Distance	600 nm
$D_{ice\ conditions}$	Distance in ice	75 nm
$D_{open\ water} = D_{total} - D_{ice\ conditions}$	Distance in open water	525 nm
$M_{i,\ voyages} = M_{LFO}$	Total fuel (LFO)	51.25 tonnes
	Fuel in ice (LFO)	7.5 tonnes
	Fuel in open water (LFO)	43.75 tonnes
LCV_{LFO}	LCV	0.041 MJ/gram

Source: ESSF WS1 – Report on calculation methodologies under Regulation (EU) 2023/1805

The steps to calculate the adjusted mass of fuel are outlined for the example as given in the table above.

Energy used – conversion of the mass of the fuel

The mass of the fuel can be converted into the energy used by applying the Lower Calorific Value (LCV) of the fuel, which, in this example, amounts to 41,000 MJ/tonne LFO:

Table 4.15 Conversion of mass to energy

LFO	Mass (metric tonne)	Energy (MJ)
Total	51.25	2,101,250
Open water	43.75	1,793,750
In ice (not adjusted)	7.5	307,500

Source: Authors, based on ESSF Workstream 1 – FuelEU Calculation Guidance

Ice derogation due to sailing in ice conditions

The energy consumption that a ship would have had if it had sailed the distance in open water instead of in ice conditions:

$$E_{voyages,ice\ conditions,adjusted}$$

$$= \frac{E_{voyages,open\ water}}{D_{open\ water}} \times D_{ice\ condition}$$

$$= \frac{1{,}793{,}750\ \text{MJ}}{525\ nm} \times 75\ nm = 256{,}250\ \text{MJ}$$

is subtracted from the actual energy consumption while sailing in ice conditions:

$$E_{additional\ due\ to\ ice\ conditions} = E_{ice\ condition} - E_{voyages,ice\ conditions,adjusted}$$
$$E_{additional\ due\ to\ ice\ conditions} = 307{,}500\ \text{MJ} - 256{,}250\ \mathbf{MJ} = \mathbf{51{,}250\ MJ}$$

This calculated additional energy consumption does, in this case, not exceed the limit of $1.3 \times E_{voyages\ open\ water} = 1.3 \times 1{,}793{,}750\ \text{MJ} = 2{,}331{,}875\ \text{MJ}$

Thus, in this example, the mass that, due to derogation 1, can be subtracted from the total fuel mass used, amounts to $\frac{51{,}250\ \text{MJ}}{41{,}000\ \text{MJ/t}} = 1.25\ \text{t}$.

Ice derogation due to ice class

To calculate the additional energy consumption due to the ice class of ships, 5% of the energy consumption that ships would have had if they had sailed in open water only is calculated:

$$E_{addition\ due\ to\ ice\ class}$$
$$= 5\% \times \left(E_{open\ voyages} + E_{ice\ conditions} - E_{additional\ due\ to\ ice\ condition}\right)$$
$$= 5\% \times \left(E_{total\ voyages} - E_{additional\ due\ to\ ice\ condition}\right)$$
$$= 5\% \times (2{,}101{,}250\ \text{MJ} - 51{,}250\ \text{MJ})$$
$$= 5\% \times 2{,}050{,}000\ \text{MJ}$$
$$= 102{,}500\ \text{MJ}$$

In this example, the mass that, due to derogation 2, can be subtracted from the total fuel mass used amounts to $\frac{102{,}500\ \text{MJ}}{41{,}000\ \text{MJ/t}} = 2.5\ t$.

Adjusted fuel mass for the calculation of the GHG intensity

In this example, the adjusted total LFO mass that can be applied for the calculation of the GHG intensity amounts to

$51.25 - 1.25\ \text{t} = \mathbf{50\ t}$ for a ship that can only apply derogation 1 (due to ice conditions)
$51.25 - 1.25\ \text{t} - 2.5\ \text{t} = \mathbf{47.5\ t}$ for a ship that can apply both derogations (ice conditions & class)

***Note on cases with multiple fuel types*:**

It should be noted that the above example is simplified, as most ships consume more than one type of fuel. In such cases, the final calculation of the adjusted mass of fuel ($M_{i,A} = M_i - E_{i,additional\ to\ ice} / LCV_i$) allows shipping companies to allocate the deduction due to ice class and navigation **to the fuels with the highest GHG intensity**, provided there is sufficient fuel amount M_i to subtract from as $- E_{i,additional\ to\ ice} / LCV_i$. This is expressed in Annex V of the Regulation as:

> *The company shall allocate the total additional ice energy $E_{i\ additional\ ice}$ to the different fuels i used during the year, with the following conditions:*
>
> $$\Sigma\ E_{i\ additional\ ice} = E_{additional\ ice}$$
>
> *For each fuel i,*
>
> $$E_{i,additional\ ice} \leq M_i \times LCV_i$$

This creates a further incentive for the uptake of low-GHG intensity fuels when operating ice-classed ships and for ships navigating in ice.

4.7 Carbon Capture/abatement systems

The onboard capture of carbon is not presently recognised under the FuelEU Maritime Regulation. That being said, the Commission is required to review the Regulation by the end of 2027. Accounting for onboard carbon capture or other abatement technologies in the calculation of a ship's GHG intensity and compliance balance is specifically mentioned as an element the Commission is required to consider in the review (Article 30(2)).

Treatment of captured carbon - The present treatment of captured carbon under FuelEU does represent a difference between this regulation and the EU ETS for shipping, where captured carbon can be accounted for to reduce the ship's GHG emissions. Shipping companies can consult the EU MRV/ETS guidance documents (Section 5.2.3 of Guidance Document no. 1 – General guidance for shipping companies: the EU ETS and MRV Maritime).

5 Fuel documentation and certification

Under the FuelEU Maritime Regulation, it is important for shipping companies to be able to demonstrate that any renewable and low-carbon fuels used by ships adhere to sustainability and GHG savings criteria defined in the Regulation and/or other EU acts. If adherence to these criteria cannot be demonstrated, the fuel will be considered under the FuelEU Maritime Regulation to have the same emission factors as the least favourable fossil fuel pathway for that type of fuel (MDO, LNG, LPG, H_2, NH_3 or methanol). The adherence of a fuel to sustainability and GHG savings criteria is demonstrated through documentation such as Bunker Delivery Notes, complemented with additional information (see Section 5.3). These documents are also necessary for calculating the WtW GHG intensity of the fuel under FuelEU (e.g., E, e_u or LCV values) as explained in Chapter 4. As such, shipping companies are advised to establish procedures to ensure fuel suppliers are aware of the importance of these documents and arrangements are made to ensure their timely exchange.

This section is not intended to be an authoritative guide to fuel documentation and certification, but rather to present major issues which should be considered by shipping companies when procuring fuels and intending to use those fuels towards meeting FuelEU requirements.

RED Certification Schemes - Detailed guidance on the functioning of RED certification schemes is available in the following document: Guidance on biomass in the EU ETS, issued by DG CLIMA. The EU MRV/ETS guidance documents (Section 9.1 of Guidance Document no. 1, General guidance for shipping companies: the EU ETS and MRV Maritime) also discusses how companies demonstrate compliance with sustainability criteria for biofuels used by ships.

This section also draws on the work available from ESSF WS2 - Report on Marine Fuels Certification Procedures to support the implementation of Fuel EU Maritime, which can be consulted for additional technical information.

For fossil fuels, FuelEU does not create any new requirements on fuel documentation or certification. As such, this chapter is concerned only with non-fossil fuels.

5.1 EU Policy Framework for certification and standards for RFNBOs

In many cases, the production pathways, feedstock, and GHG savings criteria that fuels must meet to be eligible for emission reduction benefits under the FuelEU Maritime Regulation are not defined directly within the Regulation but in other EU frameworks. These mainly include the following frameworks, as indicated in Table 5.1:

- RED (RED), the most recent version of which entered into force on 20 November (Directive (EU) 2023/2413)

- Gas and Hydrogen Directive (EU) 2024/1788

As policy frameworks interact with each other, Table 5.1 indicates secondary policies referring to terms defined in the primary policy, i.e., the regulations or directives themselves, including the underlying implementing and delegated acts.

Table 5.1 EU Policy Frameworks defining rules on sustainability and GHG saving criteria for different fuel types

Product (liquid or gaseous)	Energy input	RED	Gas and Hydrogen Directive
Biofuels / Biomethane	Biomass	Primary	Secondary
Renewable Fuels of Non-Biological Origin	Renewable sources other than biomass	Primary	Secondary
RCF	Non-renewable waste (solid/gas)	Primary	Secondary
Low-Carbon Fuels (except RCF)	Non-renewable sources	-	Secondary*/Primary

Source: ESSF WS2 - Report on Marine Fuels Certification Procedures to support implementation of Fuel EU Maritime
*Secondary as (part of) RCF defined in RED, Primary in other cases

As shown in Table 5.1, FuelEU primarily relies on the certification rules of the RED when it comes to demonstrating adherence of fuels to GHG saving/sustainability rules. The RED in particular defines:

- The **sustainability and GHG emissions saving criteria** for various fuels:
  - biofuels, bioliquids, and biomass fuels (RED Article 29)
  - RFNBOs and RCF (RED Article 29a)
- **Verification of compliance** with the sustainability and GHG emissions saving criteria for the fuel (RED Article 30)
- **Traceability** of the fuel's sustainability data along the supply chain (RED Article 31(a))

In the future, **additional rules will be defined for the certification of 'Low-Carbon Fuels'** under the Gas and Hydrogen Directive (EU 2024/1788). In particular, Article 9 of that Directive concerns the certification of renewable gas and low-carbon fuels. A commission delegated regulation to specify the methodology for assessing GHG emissions savings from low-carbon fuels has been adopted by the Commission, but at the time of writing, it is still ongoing the two-month scrutiny period for the Council and the European Parliament.

5.2 Certification schemes under RED

Article 10 of the FuelEU Maritime Regulation considers that are eligible to be taken into account for lowering a ship's GHG intensity only those fuels (1) certified under a recognised scheme and (2) whose transactions are digitally recorded in the Union Database for Biofuels

(UDB) up to the uplifting of the fuel on the ship using it. Until the Union Database for Biofuels is fully operational, registers under approved recognised certification schemes can be used.[50]

A list of approved recognised certification schemes has been established at the EU level, including both voluntary and national certification schemes. At present, these schemes are recognised in the sense that they are considered by the EC to be in accordance with the RED (in particular Articles 30(5) and 30(6)). In the future, schemes may also be recognised where they are considered in accordance with Article 9 of the Gas and Hydrogen Directive.

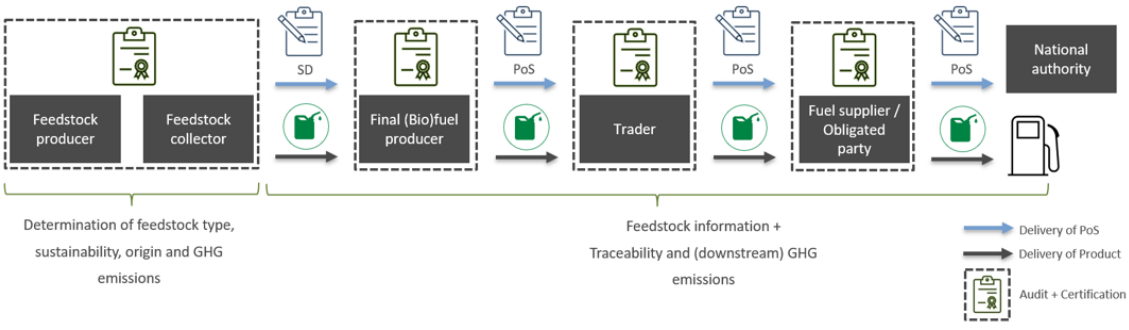
In general, the purpose of fuel certification schemes is to ensure, via auditing of participating companies in a supply chain, that:

- **Appropriate feedstocks and renewable inputs are used to produce the fuel** (i.e. non-food; correct waste residues have been used to create a certain kind of biofuel or, in the case of RFNBOs, that renewable electricity was used to create the fuel, e.g. to power electrolysers for e-hydrogen)
- **There is no double counting of emission reductions** by multiple parties taking credit for the same fuel or saved emissions (ensured primarily through a transactions' recording system, such as the UDB).

An example of a RED-certified supply chain is provided for illustration in Figure 5.1 below, showing the following features:

- Certified operators pass on sustainability and GHG information for the delivered product to the recipient in a digital or paper document (normally a 'Proof of Sustainability (PoS) – discussed in more detail in Section 5.3).
- Each certified operator in the chain is allowed to issue a PoS.
- When fuel is "delivered to the market", the PoS is surrendered to the relevant national authority to count towards a national target (meaning the original paper version, or the digital unique identifier).[51]
- The national authority aggregates the information and reports towards the EC to demonstrate compliance with the RED targets.

Figure 5.1 Simplified International Sustainability and Carbon Certification (ISCC)-EU-certified supply chain



Source: ESSF WS2 - Report on Marine Fuels Certification Procedures to support implementation of Fuel EU Maritime, based on ISCC-EU

50 Union Database for Biofuels.

51 Targets include obligations on EU Member States under Article 25 of the RED on 'mainstreaming renewable energy in the transport sector.'

Figure 5.1 also shows that the present scope of RED certification reaches from feedstock producers to fuel suppliers: all of these parties need to be RED certified and subject to audits. As the feedstock/fuel changes hands along the certified actors of the supply chain, a Proof of Sustainability (PoS) document is exchanged to evidence the sustainability properties of a fuel.

5.3 Approved forms of fuel documentation

For **shipping companies** to benefit from their use of renewable and low-carbon fuels under the FuelEU Maritime Regulation, they **need proof that the fuel meets the sustainability requirements** of the Regulation (and therefore also the RED and, where applicable, the Gas and Hydrogen Directive, in addition to the full traceability of transactions through a recording system. This proof should be in the form of documentation **provided by the fuel supplier**. This documentation should be in addition to the BDN that shipping companies are used to receiving for all fuel bunkered on board.

This sustainability documentation will be reviewed by the ship verifier after the submission of the ship's FuelEU report. In cases where the fuel's compliance cannot be confirmed by the verifier, the fuel will be counted as a fossil fuel, and the default emissions factors of the least favourable fossil fuel type will be used. As such, shipping companies need to ensure the complete and timely delivery of such documentation from fuel suppliers. Such documents are required no matter where the fuel is supplied, including outside of the EU/EEA and at sea.

For use towards FuelEU, the following items of information are especially relevant (and highlighted in Annex I of the Regulation) and could be available in the document, depending on the type of fuel.

- The Lower calorific value (LCV) of the fuel (expressed in MJ/g)
- For biofuels: a 'E' value (see Section 4.3.5)
- For RFNBOs: a 'E' and an 'e_u' value (see Section 4.3.6)
- Evidence of the production pathway of the fuels (i.e. for example, biofuels should be derived from waste, non-food crops, see Section 4.3.5)

5.3.1 Proof of Sustainability document (PoS)

The primary document to evidence the sustainability properties of a fuel is a **Proof of Sustainability (PoS) document**. This term is currently applicable for renewable fuels under the RED, i.e., biofuels, RFNBO, and RCF. For LCF, the demonstration of low-carbon properties is to be detailed once further guidance is available for the Gas and Hydrogen Directive.

A PoS declares the specific supplier and recipient of the renewable fuel. It contains general information about the product and the raw material, e.g., whether it originates from a food or feed crop or other streams, and the WtW emission factor of the fuel (or at least the values necessary to calculate the WtW emissions under FuelEU).

As shown in Figure 5.1, **a PoS is also the standard document that is shared across a certified (RED) supply chain**. This makes the PoS the most appropriate document for shipping companies to demonstrate the sustainability and emission reduction properties of the

bunkered fuel. Where possible, shipping companies should receive this document from fuel suppliers. However, fuel suppliers are at present not always in a position to share the PoS with shipping companies. This can be the case - for instance - when the fuel is supplied in an EU Member State which requires fuel suppliers to surrender PoS documents to the Member State authority so the fuel can be counted towards an increase in the national share of renewable energy in the transport sector, as mandated by the RED Article 25. In such cases, alternative documents may need to be used to provide to the shipping company (see next section).

5.3.2 Proof of Compliance (PoC)

Until the Union Database is completely operational (see next section), and in cases where a fuel supplier is not able to provide the PoS to the shipping company because of other obligations, the fuel supplier is required to complement the BDN with equivalent "evidence of compliance" as stated in point 1 of Annex I of FuelEU,[52] for example, a **Proof of Compliance (PoC).** Note however that it remains up to the FuelEU Competent Authority of the Administering State to consider the PoC, which remains a voluntary instrument issued by a certification company, as an acceptable evidence of compliance equivalent to the PoS (a similar approach is followed for MRV/ETS as referred to in the EU MRV/ETS guidance documents, specifically Section 9.2.5 of Guidance Document no. 1 – General guidance for shipping companies: the EU ETS and MRV Maritime).[53]

In any case, a PoC framework should be seen only as an interim solution pending the adaptation of the Union Database functionalities to fully integrate the PoS for the maritime industry, extending it to fuel users, which is expected to be finalised in early 2026.

5.4 Union database for liquid renewable and RCF

To support the transparency and traceability of renewable and low-carbon fuels in the maritime sector, it is foreseen to extend the Union Database for Biofuels (UDB) to marine fuels in early 2026. This extension will imply changes in how PoS and/or PoC documents are exchanged between fuel suppliers and shipping companies in the future.

The Union database is a global traceability tool established under Article 31a of the RED. Its purpose is to track consignments of renewable and RCF and the respective raw materials used for their production from the point of origin of the raw materials to the point where fuels are placed on the EU market for final consumption. This database became operational for certain certified economic sectors during 2024 with the aim to ensure market transparency and traceability in the supply chain for such fuels, mitigating the risk of irregularities and fraud and thereby supporting efforts to meet the ambitious EU decarbonisation targets.

In the current phase of the UDB, only certified RED economic operators are included in the database. This counts, for instance, feedstock producers, fuel producers, and fuel suppliers.

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[52] See the section of Annex 1 "Fuel Bunker Delivery Note (BDN)."

[53] For general guidance: the PoC framework developed by ISCC describes the conditions upon which a PoC can be issued. In principle other PoC could be defined by other sustainability regimes and considered for acceptance, providing the certification requirements under RED are met.

Each transaction between these parties is recorded electronically in the database to ensure traceability and avoid double-counting.

Shipping companies, where they only have ships *using* the fuel, and *not reselling it*, do not and will not record anything in the UDB, but might be allowed to view transactions that concern them. This is because the certified RED economic operators up to the fuel supplier only are obliged to record transactions.

Importantly, a second phase of the UDB is now planned to include ships/shipping companies in the database. The system update is anticipated to offer a PoS electronic delivery service within the database, enabling a marine fuel supplier to send a PoS to a ship operator via the specific IMO number of the ship which received the fuel as per the relevant BDN. This will negate the need for paper or electronic PoS or PoC managed outside the Union database and support a more robust traceability in maritime supply chains.

5.5 Cargo as fuel used onboard

Ships can, in some cases, use cargo as fuel, for example, LNG carriers, which may use ‘boil-off gas’ from an LNG cargo tank as a fuel. Guidance on this issue is available in Section 8.3.2 of the EU ETS and MRV Maritime General guidance for shipping companies.

In principle, under the FuelEU Maritime Regulation, the consumption in this way of bio-LNG or other lower GHG intensity fuels may be reported by shipping companies and used towards lowering a ship’s annual average GHG intensity, provided a PoS/PoC is obtained concerning the amount of fuel used.

6 Zero-Emission requirements at berth

Article 6 of the FuelEU Maritime Regulation sets zero-emission requirements for energy used by ships at berth. These requirements apply only to containerships and passenger ships and can be split into 2 categories:

1. The obligation to use 'On-Shore Power Supply' (OPS) at berth:
   - The details of the requirements are explained in Section 6.1.
2. The use of a Zero Emission Technology (ZET) at berth as an alternative to OPS
   - ZETs need to meet certain requirements discussed in Section 6.2.

The FuelEU Maritime Regulation applies the following definitions for the ship types that have to comply with Article 6:

- **Containerships**: *ships designed exclusively for the carriage of containers in holds and on deck.* Ships which do not exclusively carry containers, such as general cargo, Roll-on Roll-off (Ro-Ro), or Con-Ro, are not subject to the requirements of Article 6.
- **Passenger ships**: *ships that carry more than 12 passengers, where a passenger is every person other than the shipmaster and the members of the crew or other persons employed or engaged in any capacity onboard a ship on the business of that ship; or a child under 1 year of age.* (As defined in Article 2 of Directive EU 2016/802).

Separate from the requirements of Article 6, it should also be noted that any other ship type may use OPS or a ZET at berth; however, this is only voluntary. Section 6.3 briefly discusses this case because when these technologies are used, even if voluntarily, some technical standards and procedures do need to be kept in mind.

Pending OPS and ZET legislation - At the time of writing, important secondary legislation is still pending concerning OPS and ZETs:

1. An implementing act concerning the exchange of information between ships and ports for the intended use of OPS / ZET (as per Article 6(8)).
2. An implementing act on the detailed criteria for the acceptance of zero-emission technologies, including the definition of system boundaries and certification requirements (as per Article 6(7)).

The above secondary legislation may bring additional requirements/procedures to those discussed below. Importantly, the complete list of ports where the zero emission at berth obligation applies for container and passenger ships will also not be finalised until shortly before 2030.

6.1 Obligation to use OPS at berth

Starting from 1 January 2030, containerships and passenger ships under the scope of the Regulation must connect to OPS (or use another ZET) for their electrical power at berth in certain ports of call. More specifically, TEN-T ports.

The OPS requirement applies to all the electrical power demands of the ship. Without OPS, this power is (in general) derived on board a ship from auxiliary engines converting mechanical energy into electrical energy, which in turn feeds the ship's electrical switchboard.

Note that thermal boilers, not powered by electricity, do not fall under the OPS requirement. As such, ships operating gas or oil-fired boilers, for either hot water, vapour services, or other purposes, at berth, will not have to switch them off. However, the fuel consumption of those boilers, while at berth, will nevertheless have to be reported for GHG intensity calculations, covering energy used in EU ports.

Importantly, **OPS requirements do not apply in cases where ships are moored at the quayside for less than two hours**, calculated on the basis of time of arrival and time of departure.

6.1.1 Ports where the OPS requirement applies

The specific ports covered by this requirement are those which meet the criteria of Article 9 of the Alternative Fuels Infrastructure Regulation (AFIR). Table 6.1 below describes the types of ports where this obligation applies. Exceptions do exist, which are discussed in the following Section 6.1.2.

Table 6.1 Timeline and types of ports where containerships and passenger ships must connect to OPS or use a ZET

Timeline	Ports where the OPS obligation applies
From 1 January 2030 *Based on Article 6(1) of the FuelEU Maritime Regulation and Article 9 of the AFIR*	Trans-European Transport Network (TEN-T) core and comprehensive maritime ports, which, as an annual average between 2027 - 2029, received more than: • 100 port calls from seagoing containerships above 5000 GT. • 40 port calls from seagoing ro-ro passenger ships and high-speed passenger craft above 5000 GT. • 25 port calls from seagoing passenger ships above 5000 GT. A list of identified TEN-T core and comprehensive ports can be found in Annex II of the Union Guidelines for the TEN-T network. A map of these ports can also be found at the following link: https://webgate.ec.europa.eu/tentec-maps/web/public/screen/home. Note: the complete list of ports meeting these criteria will not be known until shortly before 2030 (since it relies on the annual average of port calls 2027 - 2029).

Timeline	Ports where the OPS obligation applies
From 1 January 2030 to 31 December 2034 *Based on Article 6(3) of the FuelEU Maritime Regulation*	In ports that are not covered by the above provisions but in which a Member State has, after consulting all relevant stakeholders, nonetheless decided to apply the requirement to that port or parts of it (i.e. certain berths or terminals). Member States must notify the Commission of such decisions 1 year before the application of the requirement. In turn, the Commission will publish a list of such ports.
From 1 January 2035 *Based on Article 6(2) of the FuelEU Maritime Regulation*	Any other port under the jurisdiction of an EU Member State where the quay is equipped with available OPS

Source: Authors, based on Article 6 of the FuelEU Maritime Regulation

Note that Article 6(11) of the Regulation permits Member States to decide that the same obligations on the use of OPS can also apply to ships' anchorage (meaning not at the quayside) within a port. That being said, it is recognised that there are presently no mature and scalable technical solutions available for the use of OPS at anchorage, so OPS obligations are in principle limited to ships moored at the quayside in port (recital 40). Still, for future years, the potential requirement to connect to OPS at anchorage should be kept in mind. Article 30(2) requires the Commission to conduct a first evaluation of the Regulation by the end of 2027. The evaluation is to include, among other aspects: the evolution of the technologies and market for renewable and low-carbon fuels and for OPS, including at anchorage.

6.1.2 Exceptions to the requirement for container and passenger ships to connect to OPS

Table 6.2 below lists the exceptions that apply, permitting ships not to connect to OPS.

Communication between the ship and port authority is essential to determine restrictions (e.g. operational/infrastructural/safety restrictions) which may require the use of these exceptions. The competent authority of the Member State of the concerned port is responsible for recording the use of the exception in the FuelEU database. Later, during the verification of a ship's FuelEU report, verifiers must confirm that the exception was reported by the competent authority.

Table 6.2 Exceptions to the requirement to use OPS for container and passenger ships

Possible exceptions to the requirement for container and passenger ships to connect to OPS when moored in an affected EU port	
1	The ship is moored at the quayside for less than 2 hours: - This must be demonstrated (and verified via the FuelEU report) based on the time of arrival/departure from the port.
2	Ships are forced to make an unscheduled port call for reasons of safety or saving life at sea: - The provisions of FuelEU in general do not apply when ships are forced to stop in port when in need of assistance, shelter or for search and rescue.
3	The OPS connection point is unavailable in the given port

Possible exceptions to the requirement for container and passenger ships to connect to OPS when moored in an affected EU port	
4	When the electrical grid stability is at risk due to insufficient available shore power to satisfy the ship's required electrical power demand at berth.[54]
5	The shore installation at the port is not compatible with the onboard onshore power equipment (provided the shore connection onboard the ship is certified as discussed in Section 3.5.1).
6	For a limited period of time only, when ships require the use of onboard energy generation, under emergency situations representing immediate risk to life, the ship, or the environment or for other reasons of force majeure.
7	Ships are also allowed to use their conventional energy generation systems when at berth, where / when they are directed to do so by authorities such as PSC, class, or flag: - For instance, a test of an emergency generator, etc.

Source: Authors, based on Article 6 of the FuelEU Maritime Regulation

Importantly, the possibility for ships to use the above exceptions without a penalty will become more restrictive from 1 January 2035 (as per Article 6(10)). After that date, exception types 3, 4 and 5 will only apply for a maximum of 10 port calls during a FuelEU reporting period (or 10% of the ship's total number of port calls in the reporting period: whichever is lower).

Ships also do not need to connect to OPS when they use a ZET instead (discussed in Section 5.3). This is because ZETs are considered to offer equivalent environmental benefits in ports (recital 39).

6.1.3 WtW emissions for electricity from OPS

By nature, OPS has zero TtW emissions, but depending on the electrical production pathway, electricity may in reality be associated with upstream WtT emissions. Nonetheless, the FuelEU Maritime Regulation stipulates that OPS should be incentivised by attributing zero upstream emissions (rated as 0 gCO_2eq/MJ) to all electricity delivered by OPS (Recital (44) and Annex I). As such, **OPS is considered to have zero WtW emissions under FuelEU**.

This is made clear in the formula for establishing a ship's GHG intensity in Annex I of the Regulation, where it is stated that the term $\sum_k^c = E_{k\ x\ CO2eq\ electricity,k}$ (sum of emissions from electricity delivered to the ship by OPS) can be set to zero.

It should, however, be noted that the zero WtW emission factor for electricity may be subject to change following a review of the Regulation due by 31 December 2027 (as per Article 30).

6.1.4 General obligations for shipping companies using OPS

The following are general obligations to be respected when OPS is used by containerships and passenger ships.

[54] The decision on the application of this exemption is the responsibility of the competent authority of the Member State of the port of call.

Technical standard for on-board OPS connection point

Onboard OPS connection points should be designed, installed, and tested in line with the technical specifications of standard IEC/IEEE 80005 for high-voltage shore connections (see Article 6(5)(f)).

Ships which do not meet this standard, and which therefore may face incompatibility challenges with shore-side infrastructure, will not be eligible for an exemption from the requirement.

OPS Guidelines - The European Maritime Safety Agency (EMSA) has produced guidelines for shore-side electricity for port authorities and administrations. The same document covers technical standards for the on-board connection point.

Advance notification to the port authority before entry

Under the FuelEU Maritime Regulation, any ship seeking to use OPS (or a ZET) in a port is obliged to notify the port authority in advance, together with the amount of power they expect to require during the port call (Article 6(8)). In turn, the port authority (or other competent authority of that Member State) should confirm to the ship whether an OPS connection is available.

Pending OPS harmonisation measures - Since the proper exchange of information between ship and shore is essential for the planning and smooth connection to OPS, a harmonised set of information to be exchanged for OPS port calls in scope of the Regulation will be developed and issued as part of secondary legislation for the FuelEU Maritime Regulation before the OPS requirements start in 2030. In order to reduce the administrative burden, consideration is being given to a simplified notification in cases of repeated OPS connections at the same terminal or berth in a port following a successful first connection.

Monitoring and reporting requirements for OPS

The use of OPS (or a ZET) needs to be reflected in a ship's monitoring and reporting systems to ensure the use of technology and energy consumed is properly reflected in the ship's FuelEU report.

As such, **there are a number of fields in a ship's FuelEU monitoring plan that become mandatory when a ship intends to use OPS** (in principle for all passenger and containerships ahead of reporting year 2030, but also any other ships intending to use OPS). These mandatory monitoring plan fields are indicated in Annex II of this guidance document.

Next to this, **ships must also ensure they receive an Electricity Delivery Note (EDN) after each period connected at berth**. The EDN should contain at least the following information:

1. Supplier: name, address, telephone number, email address, representative
2. Receiving ship: IMO number (MMSI), ship name, ship type, flag, ship representative
3. Port: name, location (LOCODE), terminal/berth
4. OPS connection point: connection point details

5. OPS time: date/time of commencement/finalisation
6. Energy supplied: power fraction allocated to supply point (if applicable) [kW], electricity consumption (kWh) for the billing period, peak power information (if available)
7. Metering.

There is no need to consider the emission factor of the grid electricity, as, pending any future amendments to the Regulation, all electricity will be treated as a zero GHG intensity source of energy.

6.2 Zero Emission Technologies as an alternative to OPS

Containerships and passenger ships, which are subject to the 'zero-emission at berth' requirements set out in Article 6 of the Regulation, may use a so-called Zero Emission Technology (ZET) as an alternative to OPS. This possibility is provided via Article 6(5)(b)

This section discusses the definition of ZETs and the kind of technologies that are currently recognised as ZETs. **Importantly, however, additional rules on ZETs (in the form of delegated or implementing acts) are pending adoption by the Commission**. Once adopted, these rules will establish, among other things, detailed acceptance criteria, system boundaries, and certification requirements for ZETs.

Zero Emission Technology means a technology that, when used to provide energy, does not result in the release of the following GHG and air pollutants into the atmosphere by ships: CO_2, CH_4, N_2O, sulphur oxides (SOx), nitrogen oxides (NOx) and particulate matter (PM).

6.2.1 Accepted Zero Emission Technologies

The following technologies are presently considered to be Zero Emission Technologies as specified in Annex III of the Regulation.

Table 6.3 Recognised Zero Emission Technologies under the FuelEU Maritime Regulation

Type of Zero Emission Technology	General requirements for operation
Fuel cells	Power supplied by onboard fuel cells with fuel or a system should, when used to provide energy, not release any of the GHGs or air pollutants mentioned above.
On-board electrical energy storage	Power supplied by on-board electrical energy storage systems previously charged via: - onboard power generation at sea. - shore-side battery charging. - battery swapping.
On-board power generation from wind and solar energy	Power supplied by on-board renewable energy sources, either directly supplying to the ship grid or via charging of on-board intermediate electrical energy storage.

Source: Authors, based on Annex III of the FuelEU Maritime Regulation

The Regulation foresees that additional Zero Emission Technologies may be considered equivalent under the Regulation at a later stage, subject to the adoption of further legal acts and after assessing technological developments.

6.2.2 WtW emissions for ZETs

An important distinction between OPS and ZETs is that **not all ZETs are considered by the Regulation to be zero WtW emissions** (even though they are referenced as an equivalent to OPS in Recital 39).

While the GHG intensity formula in Annex I of the Regulation permits emissions from electricity delivered to the ship by OPS to be counted as zero, no such reference is made for emissions for ZETs.

Although by definition, Zero Emission Technologies should not release emissions at berth (TtW emissions), this may not be true for the upstream (WtT) emissions of fuel/energy used to power the ZET. For example, if fuel cells are used as a ZET, the WtW emissions of fuel required to produce energy from the cell need to be taken into account in the GHG intensity formula. Similarly, in the case of a ZET being 'onboard electrical storage', the upstream emissions of fuel/energy used to generate the electricity for storage also need to be taken into account in the GHG intensity formula. Examples can be found in Section 3.6 of ESSF WS1 – Report on calculation methodologies under Regulation (EU) 2023/1805.

6.3 The voluntary use of OPS or ZETs

It should be noted that while FuelEU requires only passenger and containerships to use OPS or a ZET while at berth (as per Article 6), **other ship types may also voluntarily opt to use these technologies** as a means to reduce their GHG intensity (as per Article 4).

The zero WtW emission factor for OPS electricity could mean that ships reduce their GHG intensity even in cases where the ship does not change fuel (for instance, due to a lack of fuel availability or compatibility for the ship). **This can make OPS a potential compliance consideration for all ship types**. This is demonstrated in Table 6.4 for a ship replacing a share of energy consumed at berth from fuel to OPS. It can be seen that the use of OPS to replace some of the ship's MGO consumption at berth can enable the ship to reduce its GHG intensity beneath the limits set for the 2025-2029 period. This is to say that the use of OPS can be relevant for all ships under the scope of FuelEU, not only passenger and containership ships that are required to use the technology.

Table 6.4 The GHG intensity of a ship sailing in Europe on MGO with a high use of OPS

Item	Unit	Fossil MGO / OPS
WtW GHG MGO	g CO_2eq/MJ	90.77
Share of energy consumption replaced by OPS	%	1.75%
WtW GHG OPS	g CO_2eq/MJ	0
GHG intensity with the use of MGO and OPS	g CO_2eq/MJ	(1.75% x 0) + (98.25% x 90.77) = 89.2

Source: Authors, based on the FuelEU Maritime Regulation

Requirements to be respected for ships voluntarily using or planning to use OPS or ZETs

Where OPS or ZET technologies are used voluntarily by ships other than container and passenger ships, there are a number of requirements that should be kept in mind:

- Where ZETs are installed and intended to be used by the ship as a compliance strategy towards lowering its GHG intensity, the ZET should meet the same requirements set out in Section 6.2.1. This includes the detailed acceptance criteria and certification requirements, which are still pending.
- The FuelEU monitoring plan should be adapted to include OPS/ZET as an energy source.

It is also advisable that the ship's onboard OPS connection points comply with the same technical standard referred to in Section 6.1.4.

Part II – Administrative obligations

7 Compliance cycle

Compliance with the FuelEU Maritime Regulation implies, on one hand, fulfilling the legal requirements for energy used onboard ships, which are outlined in Part I of this guidance document. On the other hand, it also involves complying with a number of administrative obligations that are deemed necessary to demonstrate, monitor, and enforce compliance with the legal requirements.

The compliance cycle refers to the administrative obligations that need to be fulfilled by ships to be considered in compliance with the FuelEU Maritime Regulation. The steps and outputs of the compliance process can be viewed as a yearly cycle, which is outlined in this chapter. Further details are provided in Part II of the guidance document.

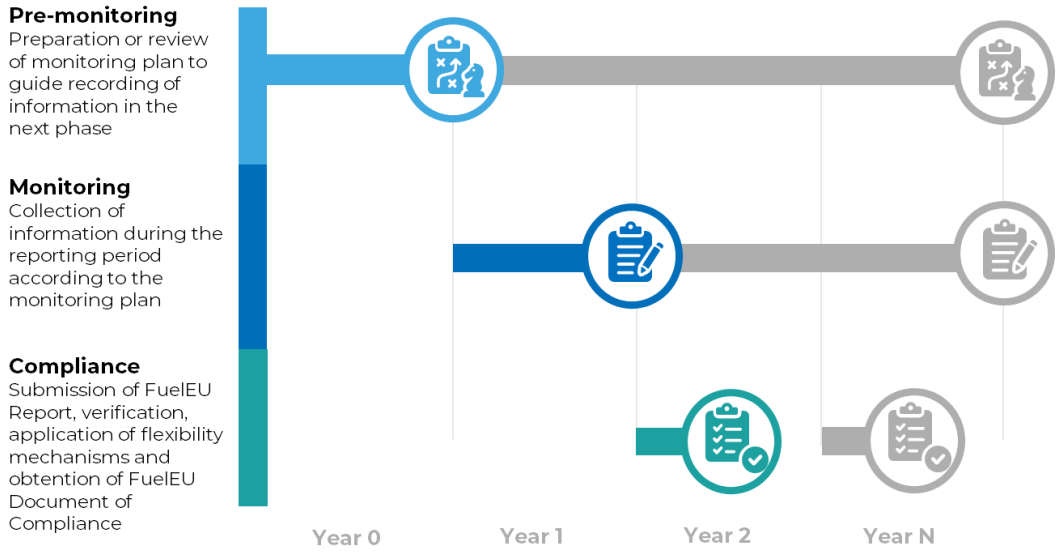
7.1 Overview of compliance

The administrative obligations under the FuelEU Maritime Regulation include:

- Producing or reviewing a **monitoring plan** that outlines the method for monitoring and reporting the amount, type, and emission factor of energy used onboard ships (Article 8 of the Regulation). This monitoring plan needs to be approved by a verifier.
- **Collecting the information** according to the monitoring plan (Article 15 of the Regulation).
- Preparing a **'FuelEU' report** containing the monitored information (Article 15(3) of the Regulation) for the verifier (Article 16 of the Regulation).
- If relevant, apply **flexibility mechanisms** (Article 20 and Article 21 of the Regulation) and pay any penalties due, if any (Article 23 of the Regulation).
- **Obtaining a FuelEU DoC** (Article 22 of the Regulation).

These steps are taken sequentially, and can be organised in different stages, as shown in the figure below. In the figure, pre-monitoring, when the monitoring plan is produced, comes first in year zero. Then, the monitoring starts the following year. In the next year, all the remaining compliance steps will take place before 30 June. This sequence is followed for every year that the ship is under the scope of the FuelEU Maritime Regulation, meaning that a given year can simultaneously involve pre-monitoring for the data that will be collected the next year, monitoring the data collected that same year, and compliance for the data collected the previous year.

Figure 7.1 Stages of the compliance cycle



Source: Authors, based on the FuelEU Maritime Regulation

7.2 Pre-monitoring

During pre-monitoring, **the company needs to submit the ship's monitoring plan, outlining how the relevant data is to be collected on a per-voyage basis, to the verifier**. The pre-monitoring plan is uploaded to the FuelEU database for the verifier to assess. Upon positive assessment that it meets the standards of the FuelEU Maritime Regulation (done within the FuelEU database by the verifiers), a version of the assessed plan is generated in the database. The monitoring plan needs to be revised if deemed necessary by the verifier, companies, or authorities.

For most ships, the first pre-monitoring corresponds to the period before the entry into force of the Regulation; more precisely, before 1 January 2025. There are instances, however, where this is different. Namely, for cases where ships only fall under the scope of the Regulation for the first time at some point after 1 January 2025. This can be the case, for example:

- For newly constructed ships
- The first time a ship calls in a port under the jurisdiction of a Member State after the Regulation entered into force, where the ship previously did not do so.

Table 7.1 below summarises the milestones to comply with and the deliverables to submit during pre-monitoring.

Table 7.1 Milestones and deliverables in the pre-monitoring period

Requirement	FuelEU Maritime Regulation
First submission of the monitoring plan to the verifier	By 31 August 2024 (Article 8(1))
	For ships falling under the scope of the Regulation for the first time after 31 August 2024: without undue delay and no later than two months after the ship's first call at a port under the jurisdiction of a Member State.

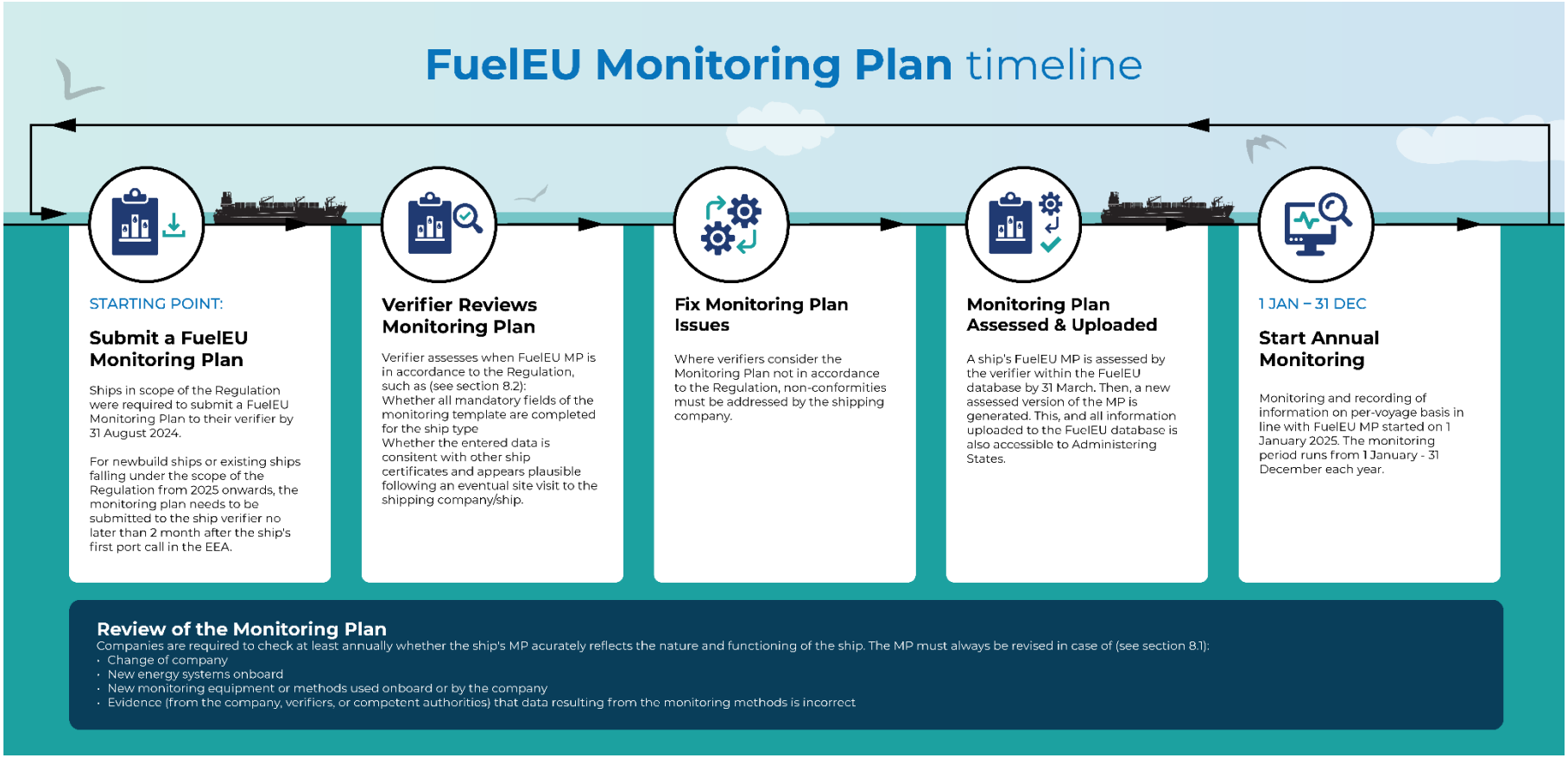
Requirement	FuelEU Maritime Regulation
	(Article 8(2))
Modification of the monitoring plan	Where the verifier's assessment identifies non-conformities with the requirements of the Regulation, the company concerned must, without undue delay, revise its monitoring plan accordingly and submit the revised plan for a final assessment by the verifier before the reporting period starts. (Article 11(1))
Submission of a verified monitoring plan	(not specified until when the monitoring plan has to be assessed by the verifier to conform with the Regulation)

Source: Authors, based on the FuelEU Maritime Regulation

Modifications to the monitoring plan - At least yearly, or under certain conditions, the monitoring plans need to be improved, corrected, or updated. For more details, please refer to Section 8.2.

Figure 7.2 illustrates the timeline of the different milestones regarding the preparation, verification, and approval of the monitoring plan during pre-monitoring.

Figure 7.2 Milestones in pre-monitoring



Source: Authors, based on the FuelEU Maritime Regulation

7.3 Monitoring

The reporting period corresponds to the calendar year in which the needed information and data need to be collected for the elaboration of the FuelEU report. In other words, this **is the calendar year in which the information will be collected**. The first reporting period, which occurs under the Regulation, is from 1 January 2025 to 31 December 2025 for most ships, while for every calendar year thereafter, a new reporting period begins as long as the ship is covered under the scope of the Regulation.

Scope - Some ships may not have been under the scope of the Regulation on 1 January 2025 (e.g. because the ship did not call in EU ports) but may fall under the scope at a later point. For these ships, monitoring starts from the moment the ship falls under the scope of the Regulation (e.g. first port call in an EU port) until the end of the calendar year.

Company transfer - Ships can be transferred between companies over the course of a calendar year. In these cases, the monitoring for the transferring company takes place until the transfer, and the information collected until then is reported in a 'partial FuelEU report.' The verification of this report needs to be done as soon as possible after the transfer of the ship. The company receiving the transferred ship takes responsibility for the monitoring for the rest of the calendar year. For more information on what happens when a ship is transferred to a new company, please see Section 9.1.

7.4 Compliance

Compliance takes place from 1 January after monitoring, until 30 June of the same year, by when the ship must hold a FuelEU DoC. In this period, the FuelEU report containing the information collected during monitoring is submitted by the company to the verifier. The verifier must assess the report and perform the relevant calculations (e.g. GHG intensity of energy used on board, and the compliance balance) to determine if the ship is compliant with the Regulation. The verifier must then upload the verification report and the calculations to the FuelEU database.

The company may choose to apply flexibility mechanisms (as outlined in Chapter 11) to address any compliance deficit or to take advantage of compliance surplus, in which case the verifier must calculate, approve, and record the new compliance balance (if the ship is part of a pool, the pool verifier may be different from the ship verifier). Finally, if any penalties are due, the company must pay them to the relevant authorities, and once there are no due penalties, the verifier (if no penalties were issued) or the administering state (if penalties were issued and subsequently paid) can issue a FuelEU DoC that needs to be held by the ship.

For the majority of ships, the first compliance under the Regulation will take place from 1 January to 30 June 2026. Every calendar year thereafter (until 30 June) will involve compliance as long as the ship is covered under the scope of the Regulation.

Ships not (yet) under the scope - Some ships may not have been under the scope of the Regulation on 1 January 2026 (e.g. because the ship did not call in EU ports) but may fall under the scope at a later point. For these ships, the first period for compliance is after the first period in which monitoring takes place (e.g. compliance takes place until 30 June of the year after the first port call in an EU port).

Table 7.2 summarises the timeline of the different milestones in compliance, as well as the different documents that need to be delivered and obtained.

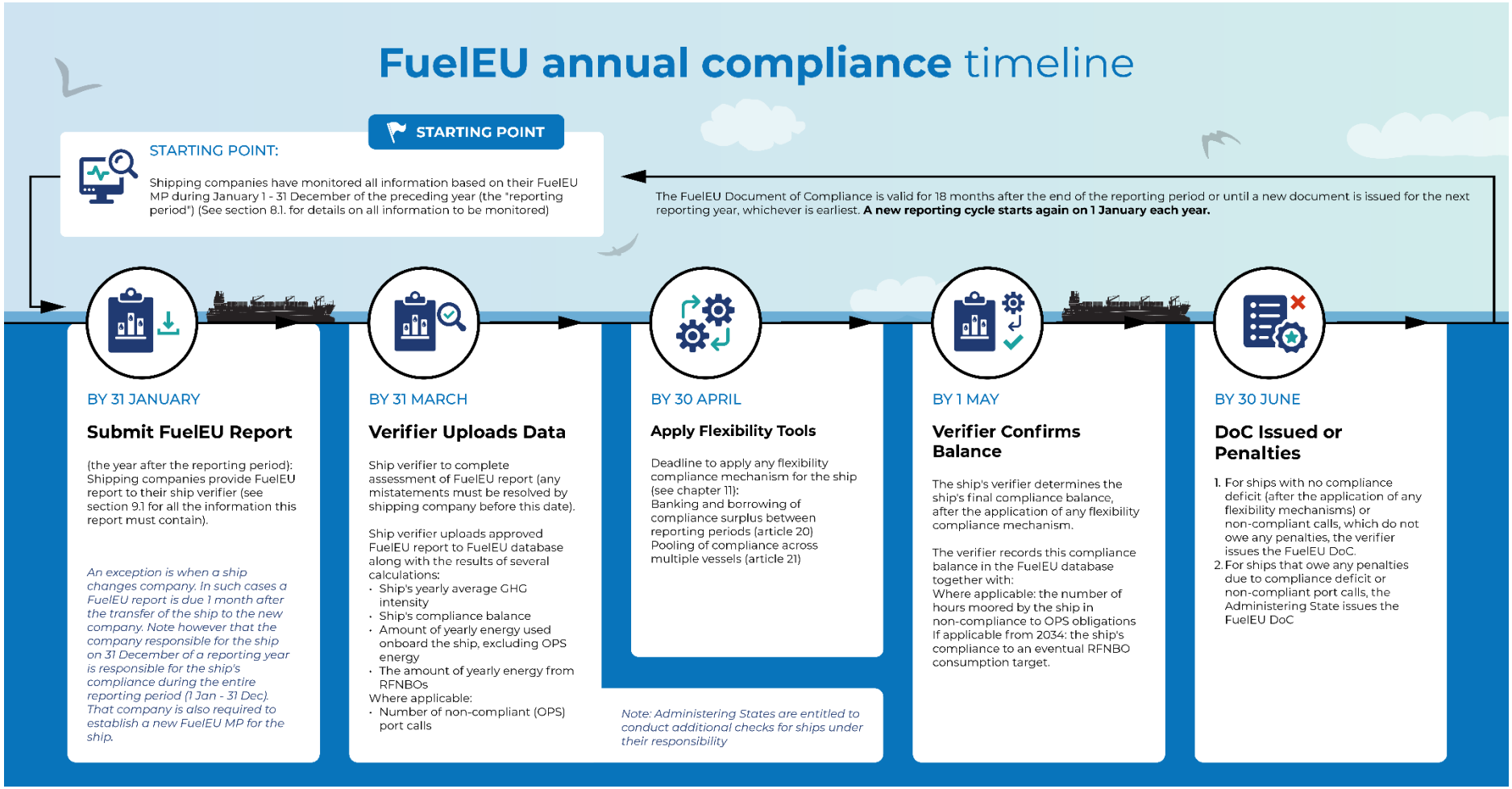
Table 7.2 Milestones and deliverables in compliance

Requirement	FuelEU Maritime Regulation
Submission of FuelEU report to verifier	By 31 January, companies have to submit the ship-specific FuelEU Report to the verifier containing all information required according to Article 15(1). The verifier will, among other things, calculate the GHG intensity of the energy used onboard and calculate the compliance balance (Article 15(3))
Correction of misstatements or non-conformities	The company has to correct the misstatements or non-conformities without undue delay after being notified of them by the verifier, to enable completing the verification process in time (Article 16(3))
Verification of the FuelEU Report and GHG intensity calculations	By 31 March, the verifier shall notify the company of the assessment of the FuelEU Report and the calculations of the GHG intensity of the energy used. This will allow the company to determine a strategy for compliance, namely if intends to use a flexibility mechanism or not.
Application of flexibility mechanisms (if relevant)	By 30 April, the results of any banking and borrowing of compliance surplus (Article 20) or pooling of compliance (Article 21) need to be recorded in the FuelEU database.
Calculation and communication of penalty (if due)	In the event of a negative Compliance Balance, the associated Administering State shall calculate and communicate the value of the due penalty to the Company by 1st June (Article 23(2))
Payment of penalty (if due)	To be paid by 30 June or following the timelines and procedures established by the relevant Administering Authority (Article 23(2))
Issuance of FuelEU DoC	By 30 June, the verifier (or administering state if any penalties are due) has to issue a FuelEU DoC for the ship concerned (Article 22)
DoC obligation	By 30 June of the verification period, ships calling at a port under the jurisdiction of a Member State, arriving at, staying within or departing from a port under the jurisdiction of a Member State, or which have carried out voyages during the corresponding reporting period, shall hold a valid FuelEU DoC (Article 24)

Source: Authors, based on the FuelEU Maritime Regulation

Figure 7.3 illustrates the timeline of compliance. In the figure, the different steps that need to be taken are outlined sequentially for a given calendar year. The figure takes as a starting point the end of the monitoring in a reporting period, and it includes deadlines for important milestones throughout the year, as they appear in the Regulation.

Figure 7.3 Milestones in the verification period



Source: Authors, based on the FuelEU Maritime Regulation

7.5 FuelEU database

The FuelEU Maritime Regulation references a '**FuelEU database**' to keep records of ship monitoring plans, verification outcomes, and the compliance balance of ships – including the application of flexibility mechanisms or penalty payments. In other words, the documented outcomes of the different steps of the compliance cycle previously described must be submitted and recorded in this database, which, according to the Regulation, should be accessible to shipping companies, verifiers, authorities, national accreditation bodies, as well as the Commission and EMSA.

The **four key documents** within the compliance cycle of FuelEU Maritime Regulation (**i.e. the monitoring plan, the FuelEU report, the verification report, and the FuelEU DoC) are to be submitted to the FuelEU database**. The database is embedded within the existing THETIS information system, developed and **maintained by EMSA** to support the implementation of relevant EU legislation. In particular, the FuelEU database can be seen as a module of THETIS MRV (developed to support the EU MRV Regulation).

A key principle of THETIS MRV is that data, once reported by a shipping company in respect of its obligations under the EU MRV Regulation, will not need to be reported again for the purposes of the FuelEU Maritime Regulation. The **FuelEU module of THETIS MRV** can be seen as the FuelEU Maritime Regulation's heart because it is where key documents are processed and stored (with different access rights per user).

THETIS MRV tutorials - Users unfamiliar with THETIS MRV are encouraged to consult tutorials produced by EMSA, which include content specific to the FuelEU Maritime Regulation.

8 FuelEU Monitoring Plan

As highlighted in Section 7.2, each ship falling within the scope of the Regulation needs to have a ship-specific FuelEU monitoring plan, which is prepared by the company and approved by the ship's verifier. Section 8.1 briefly describes the contents of the monitoring plan and when it needs to be revised. This section needs to be read in close connection to Annex I, which provides further detail on the elements to be included. Section 8.2 describes the verification of the plan.

8.1 Contents of FuelEU monitoring plan

The Regulation refers to two monitoring plans:

1. The 'initial' monitoring plan based on Article 8
2. The revised monitoring plan based on Article 9

The initial monitoring plan based on Article 8

The company of the ship is responsible for drafting the (initial) monitoring plan. **This plan indicates the method chosen for monitoring and reporting on the amount of energy used on board, the energy source(s) used, as well as the emission factor**. The method chosen needs to be in line with the methods listed in Annex I of the Regulation (Article 8(1)). The plan needs to include (i) general information on the ship, (ii) information on the monitoring procedures, (iii) information on data updates and revisions and (iv) for specific ship types of additional relevant information.

The company is also responsible for the **annual check of the plan** and drafting of the revised monitoring plan in case of substantial changes. For each ship falling within the scope of the Regulation, a monitoring plan needs to be prepared. **Companies cannot produce one monitoring plan for multiple ships**.

The FuelEU Monitoring Plan builds on the monitoring plan that companies already have in place for the EU MRV and EU ETS.[55] The content is therefore closely aligned. However, there are **supplementary requirements** for FuelEU Monitoring Plans concerning:

- WtT emissions
- OPS
- Zero Emission Technologies
- Voyages through ice

Annex II of this present guidance document provides a detailed explanation of the sections of the FuelEU monitoring plan which are new for companies and go beyond the content of the EU MRV monitoring plan. The extent of the changes between a ship's MRV and FuelEU plan depends on the type of ship and whether the shipping company intends to use OPS or zero-emission technologies.

[55] For which details can be found in the EU ETS and MRV Maritime General guidance for shipping companies.

The Commission adopted a standard template for the FuelEU monitoring plan, which is also available via the FuelEU database/THETIS environment.

Via the THETIS environment, shipping companies will have an option to create the FuelEU monitoring plan with the relevant common fields from their MRV plan automatically carried over ('cloned').[56] EMSA has also prepared a short tutorial on the FuelEU monitoring plan workflow.

For ships in scope of the Regulation during the first reporting year of 2025, the monitoring plan had to be submitted to the ship's verifier by 31 August 2024 at the latest. However, when a ship visits an EU port for the first time after this date, the monitoring plan for this ship needs to be submitted as soon as possible and no later than 2 months after the first port call (Article 8(2)).

The revised monitoring plan based on Article 9

The company is obliged to check the information included in the monitoring plan each year (Article 9). The company will need to **check whether data can be improved, corrected, or updated**. During this check, the company also needs to assess whether the plan still reflects the nature and functioning of the ship.

If changes have been identified, the monitoring plan will need to be revised. The company needs to inform the verifier about the modification as soon as possible. A revision of the FuelEU monitoring plan is always required in the following circumstances, based on Article 9(2):

I. General information

- A change of company.
- New energy conversion systems, new types of energy, new systems for connection to OPS, or new substitute sources of energy or new zero-emission technologies enter into use.

II. Monitoring methods

- A change in the availability of data, due to the use of new types of measuring equipment, new sampling methods or analysis methods used onboard or by the company, or for other reasons which may affect the accuracy of the data collected.

III. Data updates and revisions

- Companies, verifiers, or competent authorities have found that data resulting from the applied monitoring method are incorrect.
- Verifiers have identified any part of the monitoring plan as not being in conformity with the requirements of the FuelEU Maritime Regulation, and the company is required by the verifier to revise it following Article 11(1).

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[56] It is however not an obligation for shipping companies to draft the monitoring plan within THETIS MRV: companies may also use an electronic version of the template in the Annex to Implementing Regulation 2024/2031 that will be accessible in the FuelEU database. Note that there are also aspects of a ship's MRV monitoring plan that are not relevant for FuelEU and so will not be carried over (such as Table C.5. of an MRV plan on the amount of cargo or number of passengers carried.

- Companies, verifiers, or competent authorities have found that the methods to prevent data gaps and identify data errors are inadequate to ensure data accuracy, completeness, and transparency.

IV. For specific types of ship only

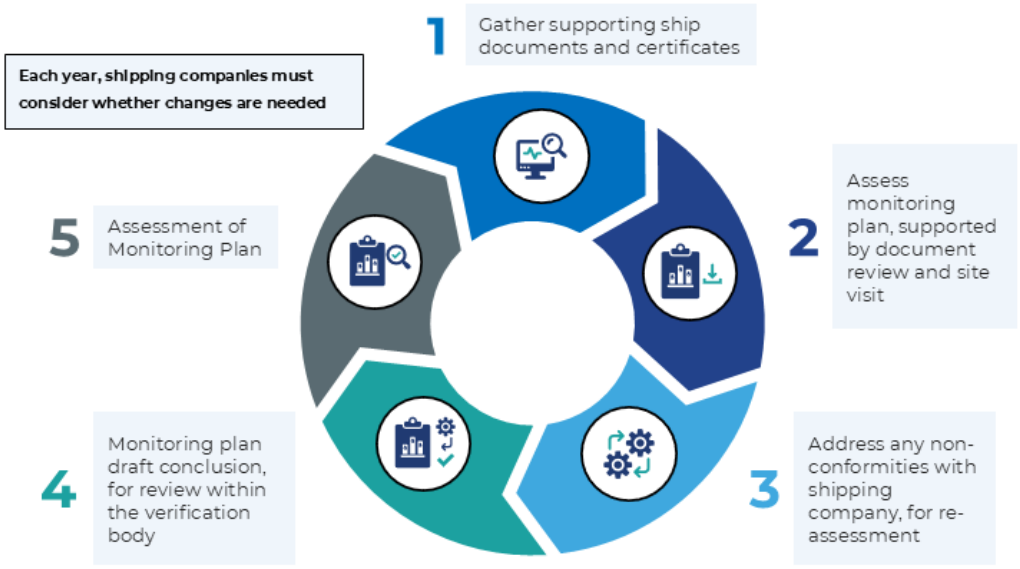
The Regulation does not include any specific revision obligations for this element.

8.2 Assessment of the monitoring plan

Once a shipping company has prepared a draft FuelEU monitoring plan, it has to be assessed by the ship's verifier. Commission Implementing Regulation (EU) 2024/2027 on verification activities prescribes several common steps that verification companies may take as orientation for assessing FuelEU monitoring plans. These steps are presented in Figure 8.1 and described in the sub-sections that follow.

Verification steps are also relevant for shipping companies, who may need to provide additional documentation (like ship certificates or company procedures) or respond to questions from the verifier.

Figure 8.1 Assessment of FuelEU Monitoring Plan - steps for verifier/verification team



Source: Authors, based on Implementing Act 2024/2027

8.2.1 Step 1 - Gather supporting ship documents and certificates

For a verifier to assess a ship's FuelEU monitoring plan, the verifier needs background information about the ship and its fuel/energy consumers. This information can later be used by the verifier to check the information provided in the monitoring plan. As such, **companies are required to provide the verifier with at least the following information**:[57]

[57] In cases where the verifier is also the classification society for the ship, they may already have access to these documents

- General descriptions of the ship's installations. This may include the ship's classification certificates or approved technical drawings sufficient to confirm the following technical aspects of the ship:
  - Energy and fuel consumers onboard
  - Fuel consumption flow meters used (where applicable)
  - Ice class information
  - Information about other sources of energy onboard

- Information on ship or company procedures which are referred to within the FuelEU monitoring plan, but without the necessary context to allow the verifier to assess them. For example, if a monitoring plan states '*see internal procedure on daily fuel reporting',* the verifier may ask for a copy of the company's internal procedure.

- A copy of the ship's Safety Management Certificate issued in accordance with the ISM Code.

- A copy of the ship's Continuous Synopsis Record (CSR) detailing the history of any previous companies managing ISM compliance of the ship.

- A risk assessment identifying how potential errors in the data flow from primary data to final data in the FuelEU report are managed.

Risk Assessment - The required risk assessment can be the same risk assessment that shipping companies undertake for the EU MRV;[58] however, it must be amended to include additional data where required for FuelEU, namely, consumption of OPS, 'Zero Emission Technologies' and fuel well to wake emissions. See the EU MRV/ETS guidance documents (specifically Section 6.2 of Guidance Document no. 1 – General guidance for shipping companies: the EU ETS and MRV Maritime) for guidance on this required risk assessment under both Regulations.

Note that the verifier is also permitted to ask the shipping company for other information the verifier deems necessary to assess the monitoring plan.

8.2.2 Step 2 - Assessing the monitoring plan

When assessing the conformity of the monitoring plan, **the verifier should, as a priority, scrutinise the following aspects** using the documents referred to above or others as deemed necessary.

- Ensure the correct monitoring plan template has been used and that all mandatory data fields for the type of ship have been completed.
- Ensure the stated shipowner and its country of registration correspond to the information recorded in the IMO Unique Company and Registered Owner Identification Number Scheme.

[58] Required by part C of Annex I of that Directive.

- Verify that the information in the monitoring plan describes the following with reasonable assurance of accuracy and completeness:
  - Fuels used
  - Other sources of energy, where applicable, such as wind-assisted propulsion and batteries
  - Measurement equipment installed onboard the ship
  - The ship and company procedures to monitor and report this data.
- Where a monitoring plan refers to sailing in ice conditions, ensure there are sufficient monitoring arrangements for such voyages.
- Verify that any existing ship/company Safety Management System (SMS) procedures or policies that are referred to in the monitoring plan are relevant for this purpose.

These aspects may also be checked via site visits to the shipping company premises or the ship concerned (see next section).

Site visits as part of the monitoring plan assessment

The Regulation also foresees that verifiers conduct a site visit to gain sufficient understanding of the procedures described in the ship's monitoring plan and validate its accuracy. **Site visits are, in principle, 'on site' – meaning in person and at the premises of the shipping company or onboard the ship**. The decision on the actual location of the site visit should be determined by the verifier, considering the place where the majority of the monitored data is stored, analysed, or managed.

Mandatory on-site visit

Site visits are always mandatory when:

1. A monitoring plan is assessed for the first time by a verifier or
2. The assessment concerns a change to a monitoring plan in the following areas:
   - Changes to ship energy installations, e.g.
     - new energy conversion systems
     - new systems for connection to OPS
     - new substitute sources of energy
     - new zero-emission technologies
   - Changes that may affect the accuracy of data collected, e.g.
     - new types of measuring equipment
     - new sampling methods
     - analysis methods
3. When companies, verifiers or competent authorities have found that data resulting from the monitoring method applied is incorrect.

Possibility for a virtual site visit (e.g. online meeting)

Site visits should take place in person, unless the verifier deems one of the following conditions to be met:

1. They have sufficient understanding of the ship's monitoring and reporting system and its effective implementation by the company.
2. When the nature and level of complexity of the ship's monitoring and reporting system do not require a physical site visit.
3. The verifier is able to obtain and assess all requisite information remotely.

4. Where serious and unforeseeable events restrict the ability of the verifier to perform an on-site visit.

Waiving a site visit

The verifier may only waive a site visit (or virtual site visit) if all of the first three conditions above are met. As stated at the start of this section, site visits (including virtual) cannot be waived when the monitoring plan would be assessed for the first time by a verifier or when the assessment concerns substantial changes to a monitoring plan.

Combine site visits - FuelEU places a focus on robust verification systems to trace compliance with the provisions of the Regulation. At the same time, administrative burden on companies, verifiers and competent authorities should be kept to a minimum. To achieve this, it is possible to combine site visits for the assessment of a ship's FuelEU Monitoring Plan and FuelEU report.

Combined site visits for fleets of ships are also possible on the condition that they are managed by the same ISM company and employ the same or similar methods for monitoring and reporting of data. This is also only possible if all ships are assigned the same verifier.

8.2.3 Step 3 - Address any non-conformities in the monitoring plan

During the assessment of the monitoring plan, the verifier may encounter cases where the plan or parts of it do not meet the requirements of the Regulation. These are referred to in the Regulation as 'non-conformities.' Where non-conformities are found, the verifier should communicate these to the shipping company and invite them to submit a revised and corrected monitoring plan for reassessment. A register of all non-conformities and how they have been resolved should be maintained in an 'internal verification document' compiled by the verifier.

8.2.4 Step 4 - Monitoring plan draft conclusion, for review within the verification body

When the verifier/verifying team are satisfied with the conformity of the monitoring plan, **they are required to submit that assessment to an 'independent reviewer'** within the verification body, alongside the '**internal verification document**.' This is the document prepared by the reviewer, which lists the supplementary documentation collected and the status of any comments the verifier clarified with the shipping company.

The 'Independent Reviewer' is defined in the legal language as *'a person assigned by the verifier specifically to carry out internal review activities, who belongs to the same entity but has not carried out any of the verification activities subject to review.'* In practice, this person is somebody from the same verification company with oversight on the assessment of FuelEU monitoring plans, but who has not actively been involved in verifying the plan of the ship in question.

‘Internal verification documentation’ means all internal documentation that a verifier has compiled to record documentary evidence and justification of activities conducted to assess the monitoring plan (or verify a FuelEU report). In practice, the independent review consults the internal verification document and discusses with the verifying team to ensure that they have requested all the relevant documentation, conducted a site visit where applicable and taken due care to ensure the monitoring plan is fit for purpose.

8.2.5 Step 5 - Assessment of the monitoring plan

If the verifier has completed the above steps and assessed the monitoring plan to be in conformity with the Regulation, the monitoring plan can be assessed as satisfactory. The verifier should include the following when informing the shipping company:

- A summary of the verifier’s procedures, including information regarding site visits, reasons for conducting virtual site visits, or the reasons for waiving site visits.
- Brief summary of the main changes to the plan, if it has been resubmitted for any of the reasons mentioned in Article 9(2) of the Regulation (see Section 8.3.2).

Assessed the monitoring plan in the FuelEU database

The verifier is responsible for assessing the monitoring plan that has been submitted to them in the FuelEU database. The verifier will then mark the monitoring plan as assessed once the assessment is completed. Via this database, the assessed monitoring plan will be accessible to the Administering State of the ship for the Regulation.

9 FuelEU report

In this chapter, a brief description of the contents of a FuelEU report is given, as well as the timeline set by the FuelEU Maritime Regulation for submitting the report and having it verified (Section 9.1). The chapter also discusses the process involved for a ship's FuelEU report to be assessed and verified, based on Commission Implementing Regulation (EU) 2024/2027 on verification activities. This is a key action of the verifier during the verification period and is discussed in Section 9.2.

THETIS MRV tutorial - Practical details for the functioning and workflow of reporting via THETIS MRV are explained in a tutorial made available by EMSA.

9.1 Preparing a FuelEU report

Based on Article 15 of the Regulation, the company of the ship needs to monitor the energy used on board the ship. **The monitoring results need to be reported on, and this is done in the so-called FuelEU report**. The company responsible for the ship needs to prepare the FuelEU report. Reporting is done in line with the monitoring mechanism(s) described in the monitoring plan and needs to be done timely and transparent manner. For each ship falling within the scope of the Regulation, a FuelEU report needs to be prepared. **Companies cannot produce one FuelEU report for multiple ships**.

Shipping companies are required to prepare a ship's FuelEU Report within the THETIS MRV environment (Article 10(1) of Commission Implementing Regulation (EU) 2024/2027). This can be seen in two phases:

1. The recording into THETIS MRV of all required data throughout the year for the ship's individual voyages and port activity. This data needs to be collected on a per-voyage basis. This means data has to be separately recorded and reported in THETIS MRV for each voyage and port call.
2. The aggregation of the data from these individual voyages and port activity from the full reporting year to create the FuelEU report. This report is due no later than 31 January of the verification period, i.e. the year following the previous (reporting) year.

In this way, a ship's FuelEU report is directly based on the data shipping companies have entered into THETIS MRV throughout the year. This is similar to the EU MRV, where companies have, for the last years, been required to create their (annual) emissions report within THETIS MRV, based on the individual voyage/port data reported throughout the year (using the 'automatic data filling' button when preparing a ship's emissions report).

Within the FuelEU Module of THETIS MRV, it will also be possible for shipping companies to automatically generate the ship's FuelEU report at the end of a reporting period, using the data that has been reported for each voyage/port activity throughout the year. During this

process, companies should ensure that the data has been aggregated correctly or, where aggregation has not been possible, add the relevant information.

Per-voyage monitoring - It is important to stress that the FuelEU Maritime Regulation requires shipping companies to monitor data on a per-voyage or per-port call basis (Article 7(1)). While the same concept in general applies under the EU MRV Regulation, that Regulation contains an exemption (Article 9(2)) from 'per-voyage' monitoring for certain ships if all of the ship's voyages during the reporting period either start from or end at a port under the jurisdiction of a Member State and the ship is scheduled to make more than 300 voyages during the reporting period.
This exemption is not applicable under the FuelEU Maritime Regulation.

Contents of the FuelEU report

The Commission developed a standard template for the FuelEU report. The template is included in Annex I of Regulation (EU) 2024/2027.

The FuelEU report should contain information on:

- Port of departure and port of arrival, including the date and time of departure and arrival and time spent at berth.
- The amount of each fuel type consumed at berth and sea.
- For each fuel type consumed at berth and sea, the WtT emission factor, the TtW emission factors of combusted fuel, and the TtW emission factors of slipped fuel associated with the different fuel consumers on board, covering all relevant GHGs.
- The amount of each type of substitute source of energy consumed at berth and sea.

In the case of **seagoing containerships** and **seagoing passenger ships** moored at the quayside **in ports where OPS is mandatory** (see Section 6.1.1), the report should also contain information on (from 1 January 2030 onwards):

- The connection to and use of OPS
- The amount of electricity delivered to the ship through OPS
- Whether or not one of the following exemptions applied (based on Article 6(5))
  - The ship was moored for less than 2 hours at the quayside
  - The ship uses approved zero-emission technologies, which replace the need for OPS
  - The ship faced unforeseen circumstances beyond its control and had to make an unscheduled port call for reasons of saving life at sea
  - The ship was unable to connect to OPS due to
    - unavailability of OPS points in the port
    - insufficiency of available shore power or risks to the grid stability
    - non-compatibility of the onboard onshore power equipment and the shore installation
  - Cases of *force majeure* hampered the ship for a limited period of time to use OPS
  - During on survey or inspection conducted by a representative of a recognised organisation (RO)

In case the ship (partially) operates in **ice conditions**, the report should also contain information on:

- The ship's ice class, if the company requests to exclude the additional energy used due to the ship's ice class from the calculation of the compliance balance.[59]
- The ship's ice class, the date, time, and position when entering and leaving ice conditions, the amount of each type of fuel consumed and the distance travelled when sailing in ice conditions, as well as the total distance travelled for all voyages during the reporting period, if the company requests to exclude the additional energy used due to sailing in ice conditions from the calculation of the compliance balance set out in Annex IV of the FuelEU Maritime Regulation.

Ship-specific - A FuelEU report is ship-specific. Unlike for the EU ETS, there is no aggregation at the company level with other ships in the company's fleet.

The report needs to be prepared on an annual basis. The company is obliged to submit the FuelEU report no later than 31 January of the year following the previous (reporting) year. The report needs to be shared with the verifier. This is done through the FuelEU database. Once the company has uploaded the FuelEU Report to the FuelEU Database, the verifier will be notified. The verifier will check the contents of the report submitted. In case the verifier identifies material misstatements or non-conformities, the company will be notified about them (Article 16(3)). The company will be asked to correct these errors without undue delay and to resubmit the report. In case the verifier does not identify any material misstatements or non-conformities, the verifier will proceed with the verification activities.

FuelEU report - Note that the ship's yearly GHG intensity is not part of the FuelEU report. This value, together with the ship's compliance balance, is determined by the ship's verifier, who first ensures the accuracy of the FuelEU report as well as the correct application of the rules within the Regulation.

Partial FuelEU report

In the event of a transfer of a ship from one company to another, **the transferring company has to submit to the verifier a FuelEU report covering the period of time the company was responsible for the ship** (so-called partial FuelEU report). No later than 1 month after the completion of the transfer of the ship, the verifier of the first company should have completed its review of the report and entered the verification report into the FuelEU database.

However, to be noted: **the company in charge on December 31 of the reporting period is accountable for compliance during the entire reporting period, regardless of company transfer(s) during the reporting period**. As such, any due penalties or the need to make use of flexibility mechanisms to ensure compliance are the new ISM company's responsibility. When a company is assuming the responsibility under the FuelEU Maritime Regulation for a

[59] In this case, the requirements of Annex IV need to be followed using the Baltic Marine Environment Protection Commission (HELCOM) Recommendation 25/7 on safety of winter navigation in the Baltic Sea to establish the correspondence between ice classes.

ship, it should ensure that previous companies have fulfilled their obligations foreseen in Article 15(4)(a) and (b), (in other words: that that company has submitted their FuelEU report to the verifier for the period they were responsible) and that there are contractual arrangements in place to cover the obligations for the corresponding periods of responsibility of those companies. If neither of the companies ensures the compliance of the ship, as a consequence, no FuelEU DoC will be issued to the ship.

9.2 Verification of the FuelEU report

Once a shipping company has submitted a ship's FuelEU report by 31 January of the verification period,[60] the verifier can start preparing its verification of the report.

The verifier has a very important role in assessing the reliability, credibility and completeness of the information contained within the FuelEU report – in particular (Article 12(2)):

- The attribution of fuel consumption and substitute sources of energy on particular voyages or at berth
- The reported fuel consumption data and related measurements, and calculations
- The choice and employment of emission factors reported by shipping companies
- The use of any OPS and the application of any exceptions to not connecting (for certain ship types)
- The completeness of BDN and fuel certification (including sustainability) documents

The verifier's **verification should be based on the following considerations** (Article 12(3)):

1. Whether the reported data are coherent in relation to estimated data that are based on ship tracking data and characteristics such as the installed engine power.
2. Whether the reported data are free of inconsistencies, in particular when comparing the total volume of fuel purchased annually by each ship and the aggregate fuel consumption during voyages.
3. Whether the collection of the data has been conducted in accordance with the applicable rules
4. Whether the relevant records of the ship are complete and consistent.

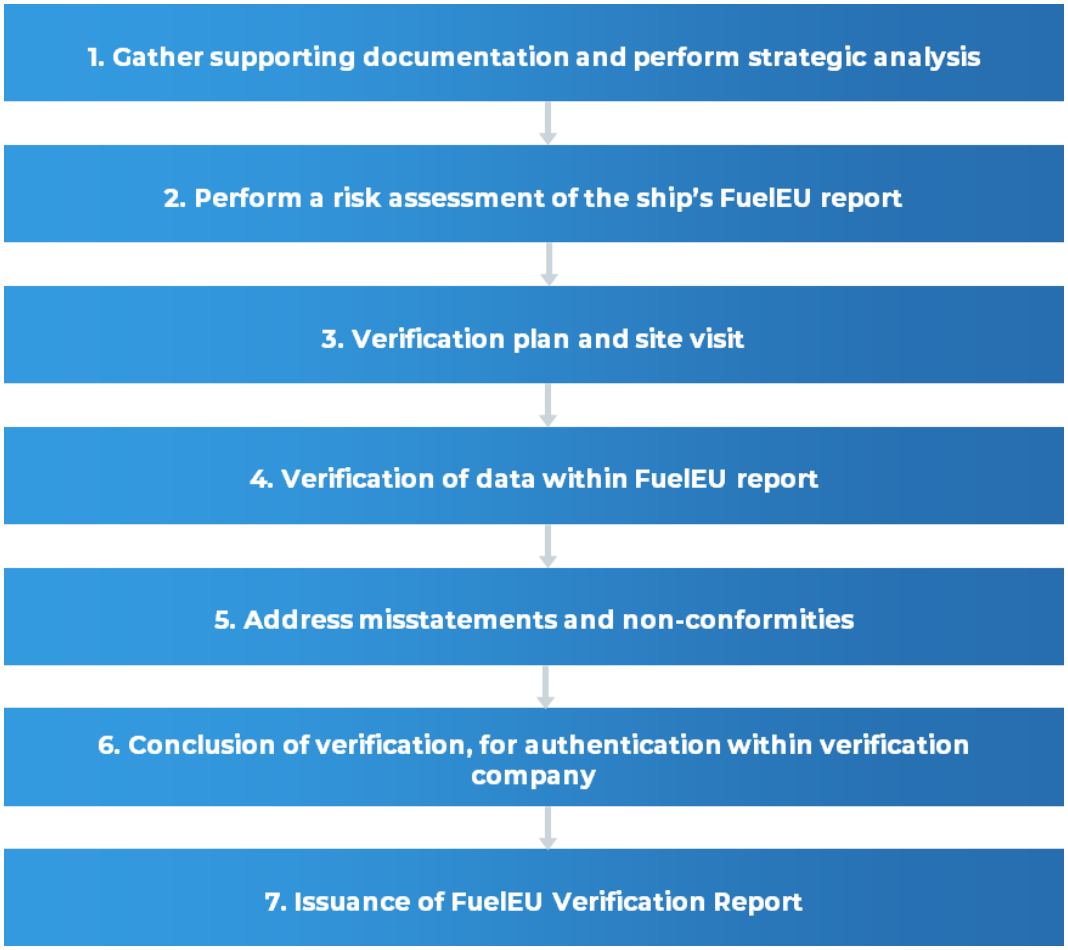
The Commission Implementing Regulation (EU) 2024/2027 on verification activities prescribes several steps that all verifiers should take when verifying FuelEU reports. In each of these steps, the shipping company may also be involved insofar as providing supplementary documentation/ship certificates or responding to queries from the verifier. The verification steps are discussed in the sub-sections that follow.

Guidance - DG CLIMA has issued Guidance for Accreditation and Verification for the EU ETS and MRV maritime, which can also be a helpful resource to verifiers for the FuelEU Maritime Regulation. Although the contents of monitoring plans and reports for these regimes are different, the methods of verification are similar. Where verification activities are similar,

[60] Or earlier in the case of partial FuelEU reports.

the following sub-sections make reference to the particular chapter in the DG CLIMA guidance for supplementary information.

Figure 9.1 FuelEU Report - verification steps



Source: Authors, based on Commission Implementing Act 2024/2027

The respective FuelEU verification steps are detailed in the sub-section that follows.

9.2.1 *Step 1 - Gather supporting documentation and perform a strategic analysis*

Commission Implementing Act 2024/2027 on verification activities requires the verifier, at the beginning of the verification period, to perform a 'strategic analysis' on the scale and complexity of the FuelEU report they are tasked to verify. During this analysis, particular attention should be given to the fuel types and energy systems used by the given ship, the number of voyages performed during the reporting period and the sophistication of dataflows used for monitoring. The goal of the strategic analysis is to ensure that a team within the verification company is assigned the correct capacity and level of competence, in line with the expected complexity of the given FuelEU report.

To perform this strategic analysis and gather the necessary background information about the ship and the relevant monitoring and reporting systems used, the verifier should ask the shipping company to provide **a series of documents to support the submitted FuelEU report**. These can include the following:

- Information on voyages:
  - List of intra- or extra-EU voyages and port calls conducted by the ship during the reporting period
  - Documentary evidence to support the stated distance travelled and time spent at sea for the ship's voyages during the reporting period
  - Documentary evidence to support stated sailing in ice conditions (i.e. relevant ice charts)

- Information on fuels/energy used:
  - BDNs
  - Copies of fuel specification sheets or (for non-fossil fuels) proof of sustainability documents
  - Electricity Delivery Notes, where applicable

- Related ship statutory documents:
  - Copy of the FuelEU report from any previous years, if the verification was performed by another party
  - The ship's approved FuelEU Monitoring Plan
  - Copies of the ship's official logbook and the oil record book, where it is separate. However, this should not be understood as *all* logbook entries, merely for sampling and/or selected periods

- List of any data gaps that occurred during the reporting period, including:
  - The number of voyages for which data gaps occurred and the reasons for that
  - The estimation method applied for gathering surrogate data
  - The amount of energy calculated based on surrogate data

- Where applicable, based on the monitoring method used by the company:
  - An overview of the IT landscape showing the data flow for the relevant ship
  - Evidence of the maintenance and accuracy or uncertainty of measurement equipment and flow meters, including calibration certificates
  - An extract of fuel-consumption data from flow meters
  - An extract of consumption data from other meters of sources of energy
  - Copies of evidence of fuel-tank meter readings
  - An extract of activity data from direct emissions measurement systems

Note that the verifier may also ask the shipping company to provide any other information relevant to the verification of the FuelEU report.

9.2.2 Step 2 - Perform a risk assessment on the reported data

Before starting the actual verification of a ship's FuelEU report, the verifier is expected to analyse the risk of misstatements or inaccuracies in the ship's FuelEU report. This risk assessment is intended to help the verifier plan the verification towards the areas of the FuelEU report with the greatest likelihood of error. It should not stop the verifier from checking all aspects of the report in detail. In case other areas of the FuelEU report prove questionable during the verification activities, the risk assessment should be revised and the verification activities repeated.

The risk assessment should encompass risks in the following senses:

- **Inherent risks**: the likelihood of misstatements in any of the report's parameters:
  - For example, due to the complexity or number of different emission sources, failure or incorrect calibration of measuring equipment, presence of significant manual data entries.
- **Control risks**: the likelihood of misstatements not being detected, prevented, or corrected by any implemented control systems:
  - For example, automated IT controls on implausible data points.
- **Detection risks**: the likelihood of a competent verifier not being able to detect such misstatements.

Guidance on potential sources of such risks is available in Section 4.2.4 of Guidance for Accreditation and Verification for the EU ETS and MRV issued by DG CLIMA.

In particular, the verifier should **consider the risk of misstatements in the following data parameters**:

- Voyage data
- Fuel consumption
- Emission factors
- Amount of energy obtained/derived from substitute sources of energy
- Inaccuracies in the aggregation of data in the FuelEU report

For example, if a verifier sees that a ship consumed a lot of blended fossil and biofuels, a risk might be that the emission factors are not correctly allocated between those two fuels.

Consider the consistency of the FuelEU report with ship tracking data

As an aid to the verifier's risk assessment, **the use of ship tracking data is encouraged**. This is in order to compare the reported amount, type and emission factor of the energy used onboard the ship with estimated data based on AIS tracking and ship characteristics such as installed engine power and fuel types used (Article 13(1) of the FuelEU Maritime Regulation).

The verifier is responsible for determining the most appropriate external ship tracking resources and keeping in mind their potential uncertainties. Where significant divergences are found, the verifier should conduct further analysis.

Guidance for verifiers on the use of such external ship tracking data can be found in Section 8.7 of Guidance for Accreditation and Verification for the EU ETS and MRV maritime issued by DG CLIMA.

9.2.3 Step 3 - Verification plan and site visit

Based on the FuelEU report and supplementary information obtained from the shipping company, and considering the risks identified during the risk assessment, **the verifier should draft a verification plan**. The plan should include:

- The nature and scope of the verification, including the data areas deemed to have the highest risk of error
- A timeframe for the verification and how it will be conducted
- A plan to assess the effectiveness of data quality control
- A data sampling plan setting out the scope and methods of data sampling relating to data points underlying fuel and electricity consumption or other relevant information

To support the verification plan, **the verifier should also make a site visit to the premises of the shipping company** or the ship concerned to gain a sufficient understanding of the monitoring and reporting systems used by the ship and company.

In principle, these **site visits are to take place in person** and at the location where the verifier considers the critical mass of relevant data is stored (in most cases, either the company's offices or the ship). Site visits are mandatory when:

- A FuelEU report is verified by a verifier for the first time
- A verifier has not conducted a site visit for the FuelEU report verification in either of the previous two years

Virtual site visits are possible when the verifier deems one of the following conditions to be met:

1. They have sufficient understanding of the ship's monitoring and reporting system, and effective implementation by the company
2. When the nature and level of complexity of the ship's monitoring and reporting system do not require a physical site visit
3. The verifier is able to obtain and assess all requisite information remotely
4. Where serious and unforeseeable events restrict the ability of the verifier to perform an on-site visit

The verifier may only **waive a site visit** (or virtual site visit) if all of the first 3 conditions above are met.

Combine site visits – The FuelEU Maritime Regulation places a focus on robust verification systems in order to trace compliance with the provisions of the Regulation. At the same time, administrative burden on companies, verifiers and competent authorities should be kept to a minimum. To achieve this, it is possible to combine site visits for the assessment of a ship's FuelEU Monitoring Plan and FuelEU report.

Combined site visits for fleets of ships are also possible on the condition that they are managed by the same ISM company and employ the same or similar methods for monitoring and reporting of data. This is also only possible if all ships are assigned the same verifier.

Before starting the verification of reported FuelEU data, the verifier should ascertain whether the reporting systems described in the approved monitoring plan exist in practice and have been followed. Performing these tasks during the site visit may make the most practical sense and could include:

- Enquiries with relevant shipping company staff, such as:

- Fleet operations manager
- Technical manager
- Environmental manager
- Fuel manager
- Quality, Health, Safety, Security and Environment (QHSSE) manager
- IT manager
- Finance manager
- Chief engineer
- Designated Person Ashore (DPA)

- Document inspection

- Observation and walkthrough of company systems or procedures that are used as part of the FuelEU data collection, such as:
  - Company (ship) Planned Maintenance System
  - IT systems that may be used to gather data on ship distance or speed, or IT-based fuel management systems

- Tracking data flows from their source to their compilation in the FuelEU report

9.2.4 Step 4 - Verification of data within a ship's FuelEU report

The verifier is required to scrutinise all aspects of the FuelEU report, with particular attention to the aspects considered to have the most risk of error (based on the verifier's risk assessment). **The following main means should be used to scrutinise the FuelEU report data**:

- Detailed testing of data by tracing them back to the primary data source
- Cross-checking data with external data sources, including ship-tracking data
- Cross-checking data in the FuelEU report with the supplementary data provided by the shipping company, e.g. BDNs
- Conducting recalculations

Table 9.1 lists the key verification items stated in Article 16(2) of Regulation (EU) 2024/2027 together with some examples of activities FuelEU verifiers may perform.

Table 9.1 Example activities - verification of a FuelEU report

Item to verify	Example of verification activity
Attribution of fuel/energy consumption on voyages and at berth	• Compare voyage duration against extracts in ship logbooks. • Check that all emissions sources listed in the monitoring plan have been considered.
Reported fuel consumption and GHG calculation	• Compare against volumes delivered to ship as stated on BDNs. • Check if the bunkered volume is plausible based on the max capacities of the ship's fuel tanks
The choice and employment of emission factors	• Check the fuel specifications on BDNs / other fuel documents and scrutinise values such as E, e_u, and LCV. Are they correctly applied in voyage reporting in THETIS MRV?

Item to verify	Example of verification activity
The use of OPS or the use of any OPS exemption	• Compare time spent at port as stated in the logbook. Check the FuelEU database for evidence of OPS exemptions possible in that port.
Certification of fuels	• Check where the fuel was bunkered and whether the sustainability chain is certified by an approved body.
The completeness of the list of fuel consumers	• If the monitoring plan lists an incinerator as a fuel consumer, but no consumption is reported: check waste receipts for evidence that waste has been discharged ashore.
The completeness of the voyages reported	• Compare against ship tracking data. • Check the logical sequences of consecutive voyages. • Check the correctness of reported voyages with regard to: - Geographical scope of the Regulation - Where relevant - calls at container transhipment ports.
The consistency between the reported aggregated data in the FuelEU report and data from relevant documentation or primary sources	• Sample specific voyages and perform a plausibility check with average fuel consumption per day.
The reliability and accuracy of the data	• Check for evidence that measuring equipment (e.g. flow meters) has been calibrated in accordance with manufacturer instructions.

Source: Authors, based on EU MRV/ETS guidance documents, specifically Table 2 of Guidance Document no. 3 – General guidance on accreditation and verification, issued by DG CLIMA

Data materiality

For data concerning fuel and electricity consumption as well as distance travelled or time spent at sea/berth, **a materiality level of 5% during the reporting period is considered acceptable**. This is the quantitative threshold or cut-off point above which the verifier must consider misstatements, individually or taken together, to be material.

A materiality level of 5% is applicable also for most aspects of the data reported for the EU MRV and EU ETS.

Guidance - Detailed guidance on materiality levels can be found in the EU MRV/ETS guidance documents, specifically Section 4.4.2 of Guidance Document no. 3 – General guidance on accreditation and verification, issued by DG CLIMA.

9.2.5 Step 5 - Address misstatements and non-conformities

Where the verifier identifies **misstatements or non-conformities** in the course of the verification of a FuelEU report, they should report them to the shipping company and **request corrections within a reasonable timeline**.

The verifier should keep a register of all correspondence with the shipping company and record how misstatements or non-conformities have been corrected. Should shipping companies not make corrections, their reasons for doing so should be justified, and the verifier

should assess the extent to which this impacts the total reported data and whether that impact leads to material misstatements.

Verifier recommendations towards the shipping company

Even if the verifier does not identify misstatements or non-conformities, **they are free to issue 'recommendations'** to the shipping company, which could improve the company's monitoring or reporting processes. Where a verifier does issue recommendations, these should be reflected in the '**internal verification documentation**' (defined in Section 8.2.4) to track in subsequent reporting years whether the company has implemented the recommendation or not. A shipping company is not required to implement the recommendation, but in cases where recommendations have not been followed, the verifier should assess whether this may increase the risk of misstatements in the FuelEU report from the period concerned.

9.2.6 Step 6 - Conclusion of verification, for authentication within the verification company

When the verifier is satisfied that all verification activities have been conducted and no material misstatements or non-conformities remain, **they should conclude the 'internal verification documentation' and the draft FuelEU report.**

These documents then need to be shared with an **independent reviewer** within the verification company. This person or team of people is required to check that the verifier has followed all verification steps with due professional care (the same process as for approval of the FuelEU monitoring plan, detailed in Section 8.2.4). Only after this is confirmed can the verifier authenticate the 'FuelEU Verification Report', which will be presented to the shipping company.

9.2.7 Step 7 - Issuance of FuelEU Verification Report

The results of the verifier's activities are presented in a **FuelEU Verification Report,** which the verifier issues to the shipping company and records in the FuelEU database. This is due no later than 31 March of the verification period (this is three months after closure of the reporting period).

The Commission developed a standard template for the verification report. The template is included in Annex II of Commission Implementing Regulation (EU) 2024/2027 on verification activities.

Verification Report - Note that the FuelEU Verification Report does not provide any information on the ship's annual GHG intensity, compliance balance, or any due penalties. The verifier only determines these in the next phase of verification (due by 31 March of the verification period or at the latest 1 month thereafter). Please also see Section 7.4.

10 Compliance balance

Once a ship's FuelEU report is verified as satisfactory, the verifier is thereafter responsible for making several calculations based on the verified report to determine the ship's compliance with the requirements of the Regulation (discussed in Section 10.2).

10.1 Introduction to the compliance balance

Compliance Balance - The compliance balance is defined in the FuelEU Maritime Regulation Article 3(35) as:
the measure of a ship's over- or under-compliance with regard to the limits for the yearly average GHG intensity of the energy used on board by a ship or the RFNBO sub target, which is calculated in accordance with Part A of Annex IV

The **compliance balance calculations determine a ship's positive compliance** due to over-achievement of the annual target (i.e., compliance surplus) **or negative compliance** balance from under-achievement of the annual target (i.e., compliance deficit). In other words, the compliance balance represents the difference between the ship's performance in a given year and the targets set up in the FuelEU Maritime Regulation.

In the case of the **GHG intensity target**, the compliance balance is in units of mass of GHG emissions (gCO_{2eq}), and it represents how many gCO_{2eq} were emitted by the ship beyond or below the allowed amount as defined by the target. In the case of the **RFNBO sub target**, the compliance balance is in units of energy (MJ), and it represents how much energy used from RFNBOs onboard the ship was beyond or below the target for RFNBOs.

At the discretion of the company,[61] ships can choose to participate in flexibility mechanisms defined in Articles 20 and 21, such as banking surplus compliance, borrowing from future compliance balance, and pooling of surplus compliance (see Chapter 11). The participation in flexibility mechanisms in the previous or current verification period has an impact on the compliance balance calculation, as described below.

In the simplest case, the compliance balance of a ship is calculated as defined in Part A, Annex IV of the FuelEU Maritime Regulation. When flexibility mechanisms have been applied in the previous or current verification period, this calculation, according to the formula in the Regulation, is known as the initial compliance balance.

When banking or borrowing of compliance surplus took place on the previous reporting period, an adjusted compliance balance needs to be calculated. When there was a banked surplus on the previous period, the adjusted compliance balance equals the sum of the initial compliance balance from the current period plus the banked surplus from the previous period. When there was a borrowed surplus on the previous period, the adjusted compliance balance is the initial

[61] 'Company' is the entity responsible for the operation of the ship according to definition FuelEU Article 3(13).

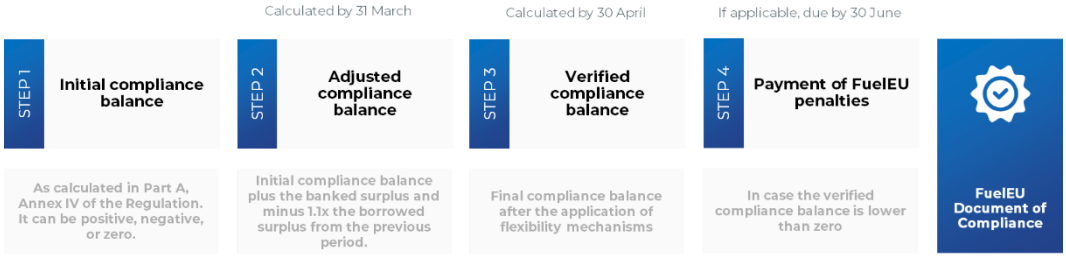
compliance balance of the current period minus the (borrowed) advance compliance surplus of the previous period multiplied by 1.1 (in other words, with a surcharge of 10%).

When there are flexibility mechanisms applied in the current period, the adjusted compliance balance is modified as foreseen according to each flexibility mechanism applied, which could result in a lower or higher balance. This compliance balance, after any flexibility mechanisms applied, is the final value recorded by the verifier and is called the verified compliance balance. More details about the flexibility mechanisms are included in Chapter 11.

The verified compliance balance is also the one considered for the issuance of a FuelEU DoC. If a ship has a verified compliance balance of zero or a surplus, the verifier can issue a FuelEU DoC. If instead a ship has a negative verified compliance balance, the company will need to pay a penalty to the relevant administering authorities. After payment, the administering authorities can issue the FuelEU DoC for the ship.

Figure 10.1 below presents the different steps in the calculation of the compliance balance, as well as the path to obtaining the FuelEU DoC. The figure shows, in the first step, the calculation of the initial compliance balance as defined in the formula in the text of the Regulation, which is the point of departure. In step 2, the adjusted compliance balance is calculated, reflecting any banking and borrowing from the previous period. In step 3, the verified compliance balance is calculated, reflecting the application of any flexibility mechanisms for the current period. Then, if applicable, step 4 concerns the payment of penalties due in case of verified compliance deficit. Finally, the company can obtain a FuelEU DoC for the ship.

Figure 10.1 Different steps in the calculation of the compliance balance



Source: Authors, based on ESSF SAPS WS1

To translate this into practical terms, the following section describes the (initial) compliance balance formula and penalty, showing how to determine whether a ship has met, exceeded, or fallen short of the annual GHG intensity target.

10.2 Calculations for a ship's FuelEU compliance balance

Having verified a ship's FuelEU report and provided the FuelEU Verification Report to the company, **the verifier is responsible for making several calculations** on the extent to which the ship complies with the Regulation's requirements (Article 16(4)). **These are**:

1. The ship's annual average GHG intensity of the energy used onboard, using the method specified in Annex I of the Regulation

2. The ship's compliance balance, using the formula specified in Part A of Annex IV to the Regulation
3. For passenger and containerships starting from reporting period 2030: the number of non-compliant port calls, including the time spent moored at the quayside and the time spent at anchorage
4. The annual amount of energy used onboard the ship, excluding energy from OPS
5. The annual amount of energy used on board the ship coming from renewable fuels of non-biological origin (RFNBOs)

The verifier is required to perform these calculations by 31 March of the verification period. The verifier should record the results of these calculations in the FuelEU database using a template provided in Annex III of Regulation (EU) 2024/2027, alongside a reference to:

- The verification report for the ship
- The ship's FuelEU report and the reporting period that was subject to verification
- The monitoring plan or plans that were used
- Any assumptions or sources of data the verifier used that they consider relevant to share in the FuelEU database

The following section focuses on the required calculations to determine the ship's compliance balance (using the formula provided in Annex IV of the Regulation). This compliance balance is strongly related to the ship's GHG intensity (calculated in accordance with Annex I of the Regulation), which has been explained in Section 4.1 but it is repeated in the following section for context. The other calculations to be performed by the verifier (the amount of energy from RFNBOs/OPS or, from 2030, non-compliant port calls) do not involve any formula or standardised calculation according to the regulation.

THETIS - Note: the THETIS environment provides a tool to aid verifiers in the above calculations based on entered (and verified) data. However, verifiers have the sole responsibility to ensure that the calculations are correct: values THETIS generates as a guide/aid and are not legally binding.

10.2.1 Compliance balance formula breakdown (Annex IV Part A)

The (initial) compliance balance formula calculates the difference between the GHG intensity target for the given reporting year ($GHGIE_{target}$) and the ship's actual GHG intensity ($GHGIE_{actual}$), scaled by the sum of total energy consumption from fuels and shore-side electricity within the scope of the FuelEU.

As specified in the FuelEU Maritime Regulation Annex IV Part A, the formula for calculating a ship's compliance balance is given as:

$$Compliance\ balance\ [gCO_{2eq}] = (GHGIE_{target} - GHGIE_{actual}) \times [\sum_{i}^{nfuel} M_i \times LCV_i + \sum_{k}^{c} E_k]$$

Variable and subscript definitions per Annex I and IV

- **gCO_2eq:** Carbon dioxide equivalent is used to compare the emissions of various GHGs based on their global warming potential. It provides a way of expressing the impact of

methane (CH_4) and N2O (N_2O) gas in terms of the amount of CO_2 that would create the same amount of warming.

- $\boldsymbol{GHGIE_{target}}$: This is the GHG intensity limit for the energy used on board the ship in a given Reporting Period, as stipulated by Article 4(2) of FuelEU.
- $\boldsymbol{GHGIE_{actual}}$: This represents the yearly average of the GHG intensity of the energy used on board, calculated for the relevant Reporting Period based on Annex I (see Section 3.1).
- $\boldsymbol{i}$: Index corresponding to the fuel types delivered to the ship in the Reporting Period.
- $\boldsymbol{M_i}$: Mass of fuel type i, consumed by the ship in terms of grams of fuel.
- $\boldsymbol{LCV_i}$: LCV of fuel type i in terms of MJs per gram of fuel (MJ/gFuel), which measures the amount of heat released by burning one gram of the fuel.
- $\boldsymbol{E_k}$: Energy in the form of electricity delivered to the ship through an OPS connection point k in terms of MJ.
- $\boldsymbol{k}$: Index corresponding to the OPS connection points.

10.2.2 Step-by-step guidance for calculating a ship's compliance balance

The following steps provide suggested best practices for how to calculate the compliance balance using the formulas provided in FuelEU. These steps are reproduced from the important work carried out by ESSF WS1 – Report on calculation methodologies under Regulation (EU) 2023/1805.

Step 1 - Determine GHG Intensity Target

The first step is to identify the $\boldsymbol{GHGIE_{target}}$ as per the specifications in Article 4(2). These have been explained in Chapter 3 but are set out once again for easy reference in Table 10.1.

Table 10.1 FuelEU GHG intensity limit on energy used on board by a ship

Timeline	Reduction Percentage	GHGIE target
From 1 January 2025	-2%	89.33680 gCO_2e/MJ
From 1 January 2030	-6%	85.69040 gCO_2e/MJ
From 1 January 2035	-14.5%	77.94180 gCO_2e/MJ
From 1 January 2040	-31%	62.90040 gCO_2e/MJ
From 1 January 2045	-62%	34.64080 gCO_2e/MJ
From 1 January 2050	-80%	18.23200 gCO_2e/MJ

Source: ESSF Workstream 1 – FuelEU Calculation Guidance and FuelEU Maritime Regulation Article 4

Step 2 - Calculate the Total Energy Consumption

The next step is to calculate the total energy consumed during the Reporting Period on voyages and port stays within the scope of the Regulation.

For energy from fuel, this requires summing the mass of each type of fuel used, applying the following formula:

$$\sum_{i}^{nfuel} M_i \times LCV_i$$

Where $\boldsymbol{M_i}$ represents the mass of each fuel type and $\boldsymbol{LCV_i}$ its corresponding LCV. Each fuel's mass is multiplied by its calorific value to convert mass to energy. The total energy from all fuels is then aggregated.

If electricity was delivered via OPS during the Reporting Period in port stays within the scope of the Regulation, it should be included using the following formula:

$$\sum_{k}^{c} E_k$$

where $\boldsymbol{E_k}$ represents the electricity in MJs delivered through each OPS connection point k. The sum of energy from both fuel and electricity provides the total energy consumption in MJs needed for the compliance balance calculation.

In case ships performed voyages covered by the exemptions provided by FuelEU Articles 2(1c), 2(3), 2(4), 2(5), and 2(6) related to voyages between EEA Member States and non-EEA Member States or voyages to Outermost Region ports, the energy calculated for the respective legs should be reduced. In addition, deductions relating to sailing in ice should also be applied (see Section 4.6)

Step 3 - Calculate the GHG Intensity Actual

The next step is to calculate the $\boldsymbol{GHGIE_{actual}}$ according to Annex I of FuelEU. This has been explained with examples in Section 4.2.

When calculating the $\boldsymbol{GHGIE_{actual}}$ for the compliance balance, the intensity of all fuel(s) and energy used onboard falling under the FuelEU scope throughout the Reporting Period should be taken into account. This calculation effectively produces a weighted average of the GHG intensity for all fuels/electricity used, adjusted for the energy content of each fuel type used. The formula is also impacted by the use of RFNBOs, ice navigation, and the use of wind-assisted propulsion.

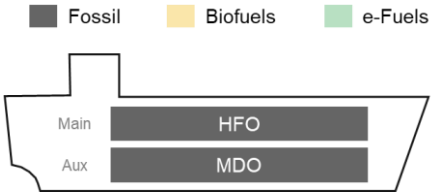
Step 4 - Compute the Compliance Balance

The compliance balance equation provides the difference between the target and actual GHG intensities($GHGIE_{target} - GHGIE_{actual}$), multiplied by the total energy consumption $[\sum_{i}^{nfuel} M_i \times LCV_i + \sum_{k}^{c} E_k]$. The result is the net compliance balance in grams of CO_2 equivalent. A positive balance indicates that the ship is performing better than the target and therefore generating a surplus. A negative balance indicates under-compliance and therefore has a deficit.

In the following sections, 3 examples are given. The first 2 involve calculating the compliance balance for ships which operated only within the EEA, and so all of the energy consumed by the ship is in scope. In the first example, only fossil fuels are used, so the fuel's WtW and TtW values derive from FuelEU Annex II, whereas in the second example, a biofuel is used, so these values derive from information obtained from fuel suppliers (example values are used). The third example takes a case of a ship that operated in both the EEA and as well as extra-EEA, so the total energy in scope of the Regulation first has to be determined. In this third example, the ship also partially consumed a biofuel, so the example illustrates how prioritisation of energy from this fuel influences the ship's annual GHG intensity and eventual compliance balance.

10.2.3 Compliance balance example 1: Fossil HFO and MDO (Intra-EEA)

The compliance balance for reporting year 2025 is calculated for a ship operating on EEA-to-EEA voyages or within EEA ports, consuming 12,000 tonnes of HFO in the main engine and 1,400 tonnes of MDO in auxiliary engines. As both fuels are fossil fuels, default emission values are all taken from the FuelEU Annex II.



In line with the 4-step approach above:

1. The target GHG intensity is first identified (89.33680 gCO_2e/MJ)
2. The ship's total energy consumption on voyages and port stays within the scope of the Regulation is calculated (545,780,000 MJ, see orange box in Table 10.2)
3. The ship's actual GHG intensity is calculated (91.63722 gCO_2e/MJ, see red box in Table 10.3. GHG intensity follows the methodology of Annex I of the Regulation)
4. The compliance balance is calculated using the values of the 3 steps above (see blue box in Table 10.3)

Table 10.2 GHG intensity calculation: Fossil HFO and MDO

Item	Unit	HFO (Grades RME to RMK)	MDO (Grades DMX to DMB)	Notes
LCV (LCV)	MJ/g	0.0405	0.0427	
Fuel used on EEA – EEA voyages or within EEA ports; 100% covered	tonnes	12,000	1,400	
Fuel used on EEA – non-EEA voyages; 50% covered	tonnes	0	0	
Energy use in scope (in million MJs)	10^6 MJ	12,000 x 0.0405 x 100% = 486.00	1,400 x 0.0427 x 100% = 59.78	486.00 + 59.78 = 545.78 10^6 MJ
WtT GHG (CO_{2eqWtT})	gCO_2eq/MJ	13.50	14.40	Fossil fuel default values are from Annex II column 4
TtW CO_2	gCO_2eq/MJ	3.114 / 0.0405 = 76.88889	3.206 / 0.0427 = 75.08197	HFO and MDO TtW emission values are found in Annex II columns 6 - 9
TtW CH_4	gCO_2eq/MJ	0.00005 / 0.0405 x 25 = 0.03086	0.00005 / 0.0427 x 25 = 0.03086	
TtW N_2O	gCO_2eq/MJ	0.00018 / 0.0405 x 298 = 1.32444	0.00018 / 0.0427 x 298 = 1.25621	
CH_4 slip (C_{slip})	%	0%	0%	
TtW GHG	gCO_2eq/MJ	TtW CO_2 + TtW CH_4 + TtW N_2O = 78.24420	TtW CO_2 + TtW CH_4 + TtW N_2O = 76.36745	
RFNBO reward (RWD)	-	1	1	Fossil fuels are not eligible for a reward

Source: ESSF Workstream 1 – FuelEU Calculation Guidance

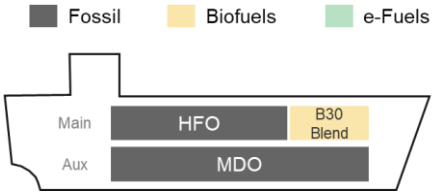
Table 10.3 Compliance balance and penalty calculations: Fossil HFO and MDO

Item	Unit	Annual totals	Notes
GHG intensity target 2025-2029 ($GHGIE_{target}$)	gCO_2eq/MJ	91.16 x (1 – 0.02) = **89.33680**	GHG intensity limit for 2025–2029, as defined in Article 4(2). Adjusts based on the reduction factor in the Reporting Period
Energy use in scope	MJ	486,000,000 + 59,780,000 = **545,780,000**	All energy in scope (now in MJ, the energy units in the compliance balance)
WtT GHG intensity	gCO_2eq/MJ	((13.50 x 486,000,000) + (14.40 x 59,780,000)) / 545,780,000 = **13.59858**	Using the default WtT emissions factors across all fuel types, divided by the total energy in scope
TtW GHG intensity	gCO_2eq/MJ	((78.24420 x 486,000,000) + (76.36745 x 59,780,000)) / 545,780,000 = **78.03864**	Adding the total emissions across CO_2, CH_4, and N_2O
GHG intensity ($GHGIE_{actual}$)	gCO_2eq/MJ	13.59858 + 78.03864 = **91.63722**	Adding together the WtT and TtW intensities
Compliance balance	gCO_2eq (tCO2eq)	(89.33680 - 91.63722) x 545,780,000 = **-1,255,523,227.6**	Here, the compliance balance is negative, meaning there is a deficit which should be addressed either through pooling, banked compliance, borrowing, or paying the penalty.

Source: ESSF Workstream 1 – FuelEU Calculation Guidance

10.2.4 Compliance balance example 2: Fossil HFO and B30 biofuel blend (Intra-EEA)

In this example, a ship primarily used HFO but also 1000 tonnes of a B30 blend, which is made of 70% HFO (700 tonnes) and 30% biodiesel (300 tonnes).



In line with the 4-step approach above:

1. The target GHG intensity is first identified (89.33680 gCO_2e/MJ)
2. The ship's total energy consumption on voyages and port stays within the scope of the Regulation is calculated (545,783,000 MJ, see orange box in Table 10.4).
3. The ship's actual GHG intensity is calculated (90.10454 gCO_2e/MJ**)**, see red box in Table 10.5. GHG intensity follows the methodology of Annex I of the Regulation)
4. The compliance balance is calculated using the values of the 3 steps above (see blue box in Table 10.5.

Table 10.4 Fossil HFO and B30 biofuel blend (Intra-EEA)

Item	Unit	HFO	HFO (portion of B30 blend)	Biodiesel (portion of B30 blend)	MDO (Grades DMX to DMB)	Notes
LCV (LCV)	MJ/g	0.0405	0.0405	0.0370	0.0427	The ship bunkers are both HFO and a B30 blend of 70% HFO and 30% biodiesel; the biodiesel LCV is from RED Annex III. The energy is 100% covered by the FuelEU
Fuel used on EEA – EEA voyages or within EEA ports; 100% covered	tonnes	11,026	700	300	1,400	
Fuel used on EEA – non-EEA voyages; 50% covered	tonnes	0	0	0	0	
Energy use in scope (in million MJs)	10^6 MJ	11,026 x 0.0405 x 100% = 446.553	700 x 0.0405 x 100% = 28.35	300 x 0.0370 x 100% = 11.10	1,400 x 0.0427 x 100% = 59.78	446.553 + 28.35 + 11.10 + 59.78 = 545.738 10^6 MJ
WtT GHG (CO_{2eqWtT})	gCO_2eq/MJ	13.50	13.50	14.9 - (2.834 / 0.037) = -61.70	14.40	Bio-diesel E values should come from the PoS; this example is FAME waste cooking oil from RED Annex V D (C_{fCO2}=2.834) from Column 6 in FuelEU Annex II
TtW CO_2	gCO_2eq/MJ	3.114 / 0.0405 = 76.88889	3.114 / 0.0405 = 76.88889	2.834 / 0.0370 = 76.59459	3.206 / 0.0427 = 75.08197	Biodiesel CH_4, and N_2O are listed in Annex II as 'TBM'; therefore, they are assigned the maximum in the fuel class
TtW CH_4	gCO_2eq/MJ	0.00005 / 0.0405 x 25 = 0.03086	0.00005 / 0.0405 x 25 = 0.03086	0.00005 / 0.0370 x 25 = 0.03378	0.00005 / 0.0427 x 25 = 0.02927	
TtW N_2O	gCO_2eq/MJ	0.00018 / 0.0405 x	0.00018 / 0.0405 x	0.00018 / 0.0370 x	0.00018 / 0.0427 x	

Item	Unit	HFO	HFO (portion of B30 blend)	Biodiesel (portion of B30 blend)	MDO (Grades DMX to DMB)	Notes
		298 = 1.32444	298 = 1.32444	298 = 1.44973	298 = 1.25621	according to Annex II. No slip for all fuel types
Slip (C_{slip})	%	0%	0%	0%	0%	
TtW GHG	gCO_2eq/MJ	TtW CO_2 + TtW CH_4 + TtW N_2O = 78.24420	TtW CO_2 + TtW CH_4 + TtW N_2O = 78.24420	76.59459 + 0.03378 + 1.44973 = 78.07811	TtW CO_2 + TtW CH_4 + TtW N_2O = 76.36745	
RFNBO reward (RWD)	-	-	-	-	-	Fossil/biofuels not eligible for reward

Source: ESSF Workstream 1 – FuelEU Calculation Guidance

Table 10.5 Compliance balance and penalty calculations: Fossil HFO and B30 biofuel blend

Item	Unit	Annual totals	Notes
GHG intensity target 2025-2029 ($GHGIE_{target}$)	gCO_2eq/MJ	91.16 x (1 – 0.02) = **89.33680**	GHG intensity limit for 2025–2029, as defined in Article 4(2), adjusts based on the reduction factor in the Reporting Period
Energy use in scope	MJ	446,553,000 + 28,350,000 + 11,100,000 + 59,780,000 = **545,783,000**	All energy in scope (now in MJ, the energy units in the compliance balance)
WtT GHG intensity	gCO_2eq/MJ	((13.50 x 446,553,000) + (13.50 x 28,350,000) + (-61.70 x 11,100,000) + (14.40 x 59,780,000)) / 545,783,000 = **12.06929**	Default WtT emissions factors for fossil fuels and a WtT factor for biodiesel based on an example value from RED Annex V D
TtW GHG intensity	gCO_2eq/MJ	((78.24420 x 446,553,000) + (78.24420 x 28,350,000) + (78.07811 x 11,100,000) + (76.36745 x 59,780,000)) / 545,783,000 = **78.03525**	Adding the total emissions across CO_2, CH_4, and N_2O and slip
GHG intensity ($GHGIE_{actual}$)	gCO_2eq/MJ	12.06929 + 78.03525 = **90.10454**	Adding together the WtT and TtW intensities
Compliance balance	gCO_2eq	(89.33680 - 90.10454) x 545,783,000 = **-419,019,440.42000** (or -419.02 tCO_2eq)	Despite bunkering 1000 tonnes of B30, the compliance balance is negative, meaning there is a deficit
Penalty	EUR	|-419,019,440.42000| / (90.10455 x 41,000) x 2,400 = **272,217**	Calculated following the penalty formula in Annex IV Part B and reflecting the period 2025 - 2029

Source: ESSF Workstream 1 – FuelEU Calculation Guidance

10.2.5 Compliance balance example 3: Fossil MGO and HVO (intra EEA and extra EEA)

The compliance balance for reporting year 2025 is calculated for a ship operating on EEA and extra-EEA voyages, consuming 2,000 tonnes of HVO on extra-EEA voyages and 5,000 tonnes of Fossil MGO on intra-EEA voyages. The example demonstrates how to gather the energy in the scope of the Regulation, as well as how lower GHG intensity fuels may be prioritised towards lowering the ship's annual GHG intensity.

In line with the 4-step approach above:

1. The target GHG intensity is first identified (89.33680 gCO_2e/MJ)
2. The ship's total energy consumption on voyages and port stays within the scope of the Regulation is calculated (193,500,000 MJ, see orange box in Table 10.6: this is the energy in scope that has been prioritised to include the full portion of energy derived from the lower GHG intensity (HVO)
3. The ship's actual GHG intensity is calculated (65.02034 gCO_2e/MJ**)**, see red box in Table 10.7. GHG intensity follows the methodology of Annex I of the Regulation)
4. The compliance balance is calculated using the values of the 3 steps above (see blue box in Table 10.7)

Table 10.6 GHG intensity calculation: Fossil MGO and HVO

Item	Unit	Fossil MGO	HVO	Notes
LCV (LCV)	MJ/g	0.0427	0.044	The LVC for the HVO is an example deriving from Annex III of the RED
Fuel used on EEA – EEA voyages or within EEA ports; 100% covered	tonnes	2000	0	
Fuel used on EEA – non-EEA voyages; 50% covered	tonnes	3000	2000	
Energy use in scope (in million MJs)	10^6 MJ	(2000 x 0.0427 x 100%) + (3000 x 0.0427 x 50%) = 149.5	(0 x 0.0440 x 100%) + (2000 x 0.0440 x 50%) + = 44.0	The total energy in scope of the Regulation is thus 193.50 0^6 MJ
Total energy use (according to prioritised allocation)	10^6 MJ	193.5 - 88.0 = 105.5	(2000 x 0.0440) = 88.0	As established in Section 4.4, fuels can be freely allocated towards a ship's total energy scope within one calendar year, provided they have been reported under the MRV Regulation. In this case, all of the energy from the HVO is prioritised since it has a lower WTW GHG intensity than MGO.

Item	Unit	Fossil MGO	HVO	Notes
				Therefore, the full energy deriving from HVO is first allocated 88 MJ. The remaining energy in scope (193.50 – 88) is thus assigned to Fossil MGO.
WtT GHG (CO_{2eqWtT})	gCO_2eq/MJ	14.4	32.9 - 70.80 = -37.90	Fossil fuel default values are from Annex II column 4. Note: the value 32.9 is an assumed 'E' value and should be retrieved from the RED certified fuel supplier. For certain fuels, the value can also be found in Annex V of the RED. The value 70.80 is the result of the fuel's CO_2 emission factor (3.115) divided by the LCV. See column 4 of the table in FuelEU Annex II.
TtW CO_2	gCO_2eq/MJ	3.206 / 0.0427 = 75.08	3.115 / 0.044 = 70.80	TtW emission values are found for MGO and HVO in FuelEU Annex II columns 6-9
TtW CH_4	gCO_2eq/MJ	0.00005 / 0.0427 x 25 = 0.03	0.00005 / 0.044 x 25 = 0.03	
TtW N_2O	gCO_2eq/MJ	0.00018 / 0.0427 x 298 = 1.26	0.00018 / 0.044 x 298 = 1.22	
CH_4 slip (C_{slip})	%	N/A	N/A	
TtW GHG	gCO_2eq/MJ	75.08 + 0.03 + 1.26 = 76.37	70.80 + 0.03 + 1.22 = 72.05	
RFNBO reward (RWD)	-	1	1	Fossil fuels not eligible for reward
WtW GHG	g CO2eq/MJ	14.40 + 76.37 = 90.77	-37.90 + 72.05 = 34.15	

Source: Authors, based on ESSF Workstream 2 – Greenhouse Gas (GHG)/Sustainability Certification of Marine Bunker Fuels

Table 10.7 Compliance balance and penalty calculations: Fossil MGO and HVO

Item	Unit	Annual totals	Notes
GHG intensity target 2025-2029 ($GHGIE_{target}$)	gCO_2eq/MJ	91.16 x (1 – 0.02) = **89.33680**	GHG intensity limit for 2025–2029, as defined in Article 4(2). Adjusts based on the reduction factor in the Reporting Period

Item	Unit	Annual totals	Notes
Energy use in scope	MJ	149,500,000 + 44,000,000 = **193,500,000**	All energy in scope (now in MJ, the energy units in the compliance balance)
WtT GHG intensity	gCO_2eq/MJ	((14.4 x 105,500,000) + (-37.90 x 88,000,000)) / 193,500,000= **-9.38501**	Using the default WtT emissions factors across all fuel types, divided by the total energy in scope
TtW GHG intensity	gCO_2eq/MJ	((76.37 x 105,500,000) + (72.05 x 88,000,000)) **/** 193,500,000 = 74.40535	Adding the total emissions across CO_2, CH_4, and N_2O
GHG intensity ($GHGIE_{actual}$)	gCO_2eq/MJ	**-**9.38501 + 74.40535 = **65.02034**	Adding together the WtT and TtW intensities
Compliance balance	gCO_2eq (tCO_2eq)	(89.33680 – 65.02034) x 193,500,000 = **4,705,235,010**	Here, the compliance balance is positive, meaning the ship can choose to bank the surplus or use it towards a pool with other ships

Source: Authors, based on ESSF Workstream 2 – Greenhouse Gas (GHG)/Sustainability Certification of Marine Bunker Fuels

10.2.6 Rounding rules for FuelEU calculations

The FuelEU Maritime Regulation does not define specific rules for the rounding of values in calculations used in the context of the Regulation.

It is recommended to apply the rounding conventions used in the EU Monitoring, Reporting, and Verification (MRV) system, THETIS MRV,[62] which is used to collect and manage data under the EU MRV Regulation (EU) 2015/757. Alignment with MRV conventions minimises calculation discrepancies between regulatory frameworks.

In alignment with MRV, **it is proposed to round to five decimal places for all values involved** in the calculations. It should be avoided to round intermediate results to avoid deviations. The only exception is in the penalty calculation, where the final penalty amount should be rounded to the nearest integer.

[62] For further guidance see the THETIS MRV page on the EMSA website.

For example, if you convert the following compliance balance to tonnes of CO_2eq:

$$-1{,}255{,}610{,}552.4 \div 10^6 = 1{,}255\ tonnes\ CO_2eq$$

and convert back to grams CO_2eq, you get the following compliance balance:

$$-1{,}255 \times 10^6 = -1{,}255{,}000{,}000\ g\ CO_2eq$$

This leads to a different result in the penalty calculation.

Note on rounding to tonnes: In practice, companies may choose to estimate their compliance balance in units of tonnes CO_2eq. When (verifiers) do the actual (compliance balance) calculation, this should be avoided.

10.2.7 Right to request review of verifier calculations and measures

If a (shipping) company disagrees with calculations or measures addressed to them from the verifier, then the company can, according to Article 26, apply for review. In such cases, shipping companies should lodge applications for review with the competent authority of the Member State in which the verifier is accredited within one month of the notification of the result of the calculation or of the measure by the verifier.

The shipping company's right to request a review includes a verifier's refusal to issue a FuelEU DoC.

11 Flexibility mechanisms

The FuelEU Maritime Regulation foresees the possibility of applying flexibility mechanisms to help companies comply with the requirements on the energy used on board the ship. Namely, these are banking and borrowing of compliance surplus (Article 20 of the Regulation) and pooling of compliance (Article 21 of the Regulation). These mechanisms can be used on the compliance balance of the GHG intensity, or if relevant, on the compliance balance of the RFNBO sub-target.

11.1 Overview of flexibility mechanisms

Before applying flexibility mechanisms, **the point of departure is the adjusted compliance balance**, as defined in Chapter 10. The adjusted compliance balance accounts for the energy consumption of the ship in the current period, as well as for any banked or borrowed surplus compliance from the previous period. This means that, for example, if a ship banked surplus in the previous period, this is added to the compliance balance again before the application of flexibility mechanisms. If, on the contrary, a ship borrowed an advance compliance surplus in the previous period, this is deducted from the compliance balance (multiplied by 1.1, or in other words, with an additional 10%, as elaborated below).

The adjusted compliance balance may result in a surplus, a deficit, or a value of zero, and based on this result, companies can choose to:

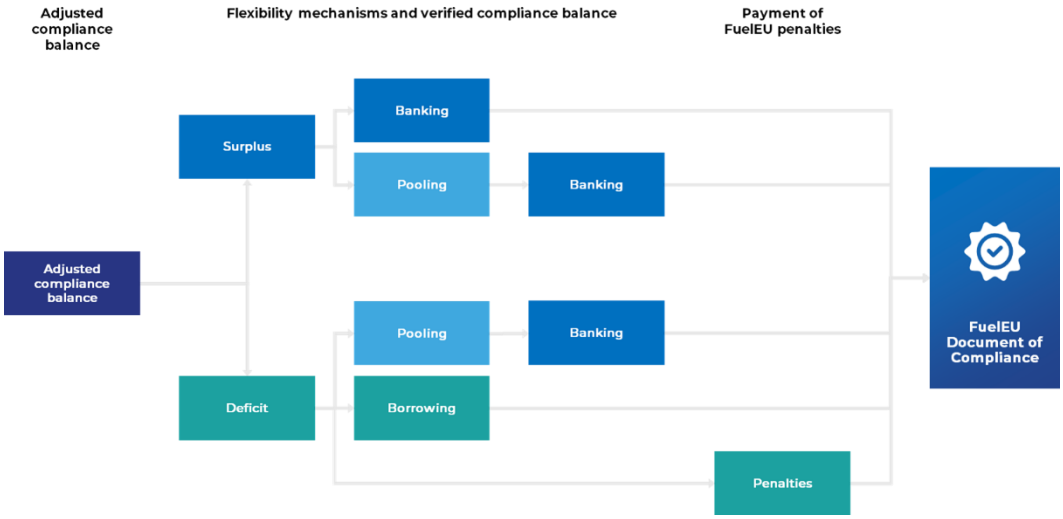
1. **Do nothing** (e.g. because the ship is already compliant or the company prefers to proceed directly to penalty payments for any deficit)
2. **Banking of compliance surplus for the next** period (e.g. to use the compliance surplus in a later year when it may be more difficult to comply with the targets)
3. **Borrowing of advance compliance surplus** (e.g. to cover a deficit in the current period)
4. **Pooling of compliance** (e.g. to reallocate the compliance between a group of ships following private agreements, either to cover a deficit, or to sell a surplus to another ship or company)

Some combinations of these mechanisms are also allowed. For example, if after pooling compliance the ship has a remaining compliance surplus, the company may still choose to bank it for a future year. Pooling and borrowing, however, cannot be done simultaneously in the same period.

The use of flexibility mechanisms to obtain a FuelEU DoC is exemplified in Figure 11.1. In the figure, a ship with surplus may choose to do banking or do pooling (with a possibility for banking any remaining surplus). A ship with a deficit may choose pooling or borrowing, but cannot do both simultaneously. A ship with a deficit may participate in a pool and result in a compliance surplus, in which the ship is allowed to bank the surplus before obtaining the FuelEU DoC from the verifier. If, after application of all relevant flexibility mechanisms, a ship is compliant according to its verified compliance balance, it will be able to obtain a FuelEU DoC from the ship verifier. If a company is not able to make the ship's verified compliance

balance in line with the Regulation requirements, a penalty payment will be due (Article 23), which is to be paid to the administering State. After payment of this penalty, the ship will still be able to obtain a FuelEU DoC from the administering State.

Figure 11.1 Options for compliance



Source: Authors, based on EMSA

It is worth noting that **the figure above is not exhaustive of the possible courses of action** and is meant for illustrative purposes only. A ship may also, among other things, decide not to bank any surplus after pooling, or a ship may still have a deficit after pooling and thus need to pay penalties.

Timeline for the application of flexibility mechanisms - The verified compliance balance needs to be calculated and recorded in the FuelEU database before 30 April. This means that all flexibility mechanisms need to be applied and also recorded by this date. The timeline for the compliance balance is further detailed in Chapter 10.

11.2 Banking and borrowing

11.2.1 Borrowing of compliance

When, after calculating the adjusted compliance balance for a reporting period, an individual ship has a compliance deficit, the company may borrow an advance compliance surplus from the ship's following reporting period (Article 20(2)). The advance compliance surplus shall be added to the ship's adjusted compliance balance of the current period by the verifier (resulting in the verified compliance balance). The advance compliance surplus must be recorded in the FuelEU database by 30 April of the verification period.

The ship should repay the advance compliance surplus in the next period, with an additional 10%, or equivalently, multiplied by 1.1. This is known as the aggravated advance compliance surplus. The aggravated advance compliance surplus needs to be deducted from the next period's initial compliance balance to produce the adjusted compliance balance.

For the purposes of the calculation of the aggravated advance compliance surplus, the GHG intensity target from the current reporting period is applied, and not the one from the next reporting period. This means that the ship uses the less stringent GHG intensity target even if the ship is borrowing from a period when a lower (more stringent) target will apply.

The advance compliance surplus may not be borrowed:

- for two consecutive reporting periods
- for an amount exceeding more than 2 % of the limit set out for the reporting period in which the ship is borrowing, multiplied by the energy consumption of the ship

Example - A ship consumes 854,000,000 MJ of energy in 2025, when the target is 89.34 g CO_2eq/MJ. The limit of 2% would amount to 1.79 g CO_2eq/MJ, or 1,525,927,200 g CO_2eq, which means that a ship cannot borrow compliance if the deficit exceeds that amount.

A ship also cannot borrow if the ship is part of a pool. Pooling and borrowing cannot be done simultaneously in the same reporting period (Article 21(7)), but a ship with an advance compliance surplus from a previous reporting period can participate in a pool (Article 21(6)).

Figure 11.2 shows how the borrowing of compliance works, where a ship with a deficit borrows an advance compliance surplus to be compliant, and then in the next year the ship must compensate with a surplus of at least 1.1 times the borrowed compliance (i.e. increased by an additional 10%).

Figure 11.2 Example of borrowing of compliance

Source: Authors, based on EMSA

A ship can borrow an advance compliance surplus in a year, and then the next year, to not call in any port in the Union (and thus not be covered under the scope of the FuelEU Maritime

Regulation). In these cases, a penalty will be due, corresponding to the penalty that would have been paid by the ship without borrowing the previous year. The competent authority of the administering State shall notify the company concerned of the amount of the FuelEU penalty that it initially avoided by means of borrowing that advance compliance surplus by 1 June of the verification period. For more information on penalties, please see Chapter 12.

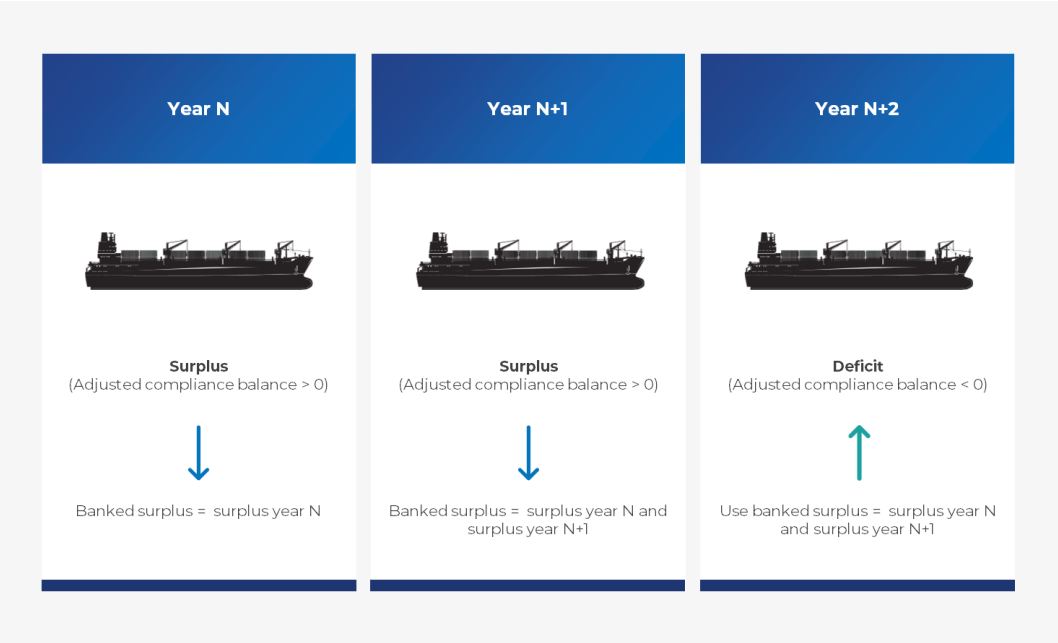
11.2.2 Banking of compliance

When, after calculating the adjusted compliance balance for a reporting period, or after participating in a pool, **an individual ship has a compliance surplus, the company may bank it for the following reporting period** (Article 21(1)). This means that the next reporting period, when calculating the adjusted compliance balance, this banked surplus will be added to the initial compliance balance. The verifier, upon request from the company, shall record the banking of the compliance surplus in the FuelEU database. The banking of compliance surplus must be done before obtaining the FuelEU DoC, as the company may no longer bank the compliance surplus once the FuelEU DoC has been issued.

Banked surplus does not have an expiration date, which means that, contrary to the borrowing case, a ship may use banking for an unlimited number of subsequent years. Additionally, banking is allowed to be done together with pooling in the same year. For example, a company may choose to bank any surplus remaining after participating in a pool (in addition to offering banked compliance surplus from a previous year in a pool).

The figure below illustrates how the banking of compliance works. In it, a ship banks a compliance surplus for two subsequent years. Then, in a third year, the same ship has a compliance deficit and uses the banked compliance surplus to compensate. It is possible that the banked surplus exceeds what is needed to make the ship compliant in this third year, and this surplus can be banked again for use another year. It is also possible that the banked compliance surplus is not enough to offset the deficit in this third year, and the company needs to consider applying further flexibility mechanisms or opting to pay a penalty to be able to obtain a FuelEU DoC.

Figure 11.3 Example of banking of compliance



Source: Authors, based on EMSA

Finally, if a ship has a surplus of compliance even after pooling, but it does not register its decision to bank it before obtaining a FuelEU DoC, the surplus will be cancelled, while the ship will still be deemed compliant, and as such, no penalties will be incurred.

Banking and borrowing - Banking and borrowing of compliance can be done in regard to the GHG intensity compliance balance, but also for the RFNBO sub-target compliance balance, if applicable. The banking and borrowing for RFNBO occur independently of the banking and borrowing for GHG intensity (e.g. a single ship can simultaneously bank compliance for one and borrow for the other).

11.3 Pooling

Pooling is a flexibility mechanism in the FuelEU Maritime Regulation that allows ships with a compliance surplus to transfer it to other ships, or ships with a compliance deficit to get surplus transferred to them. **The ships participating in a pool may be either from the same company or from different companies**, following private arrangements to sell and/or buy compliance surplus and deficits.

Two or more ships can pool their compliance balances. This means that the compliance balances of all the ships in the pool get transferred between ships according to the agreements made for each ship in the pool.

Pooling is done according to private agreements between companies, and pool formation services are not offered by the EC or national authorities. There is no set cost for pooling under the Regulation, nor are there additional rules on how the pooling agreements shall be

concluded between companies beyond the pool requirements. Any costs and other contractual responsibilities are determined by private agreements between the participating companies.

Pooling applies to all ships within the scope of the FuelEU Maritime Regulation, regardless of type or size, but the ships and **pools must meet the following requirements**:

- All the ships are in the scope of the FuelEU Maritime Regulation[63]
- The ship has not borrowed compliance in the current verification period (Article 20(7))
- The total pool compliance balance must be positive or zero (Article 21(4))
- All the ships in the pool must hold a valid FuelEU Document of Compliance from the most recent verification period during which they were within the scope of the Regulation (Article 21(5))

Total pool compliance balance - The sum of the (adjusted) compliance balances of all ships included in the same pool is referred to as the total pool compliance balance.

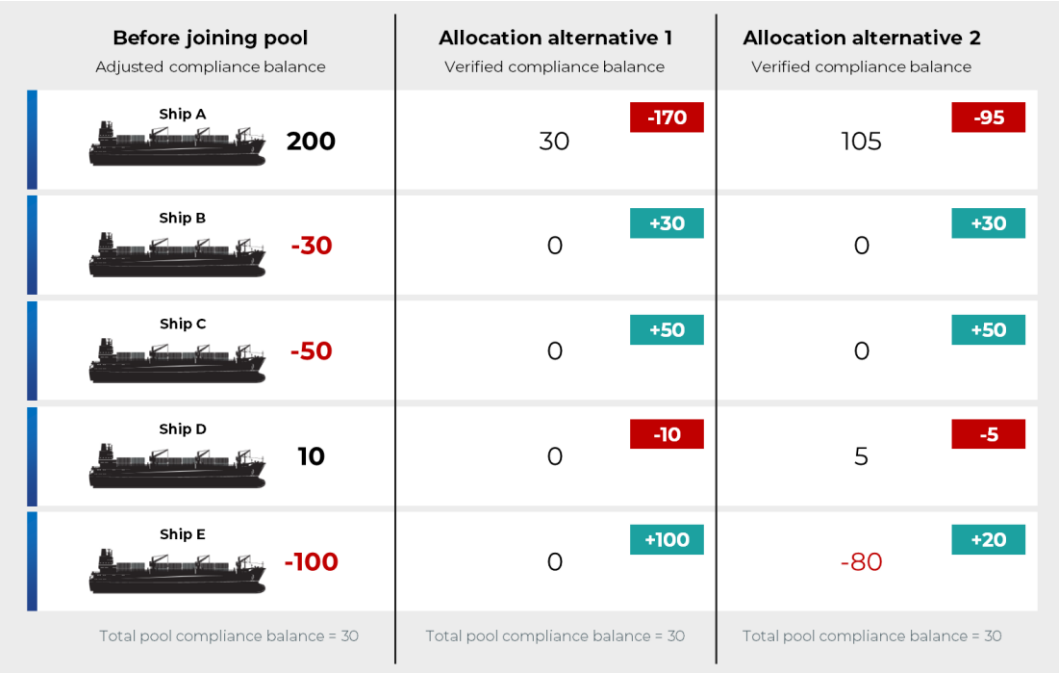
Regarding the allocation of compliance to each ship in the pool, it is possible for ships to exit the pool with a deficit, provided that the total pool compliance balance is zero or positive. Additionally, ships that had a compliance deficit before pooling cannot have a worse deficit after pooling, and ships with a surplus cannot end up with a deficit after pooling. It is also possible to join a pool where all ships are already compliant, to simply reallocate the compliance surplus between ships.

Pooling of compliance can be done regarding the GHG intensity compliance balance, but also for the RFNBO sub-target compliance balance, if applicable. There can be separate pools for GHG intensity and RFNBO sub targets on the same period, but a ship may only be part of a single pool for any of them (Article 21(1)).

Figure 11.4 exemplifies a set of ships forming part of a pool, detailing two different options of how their compliance balances may be allocated. The first column shows the (adjusted) compliance balances of the ships before joining the pool, showing two ships with surplus, three ships with deficit, with a positive total pool compliance balance. In the first allocation alternative, the balance of the ships with surplus is used to completely compensate for the deficit of the other ships, resulting in a pool with no ships in deficit. In the second alternative, the ships with surplus only partially compensate the deficit of one of the ships (ship E), which means that the ship will still be subject to the payment of penalties to obtain a FuelEU DoC proportional to the remaining deficit. In either of the allocations, the ships with remaining surplus may bank this surplus after the pooling. The total pool compliance balance remains the same across all allocations.

[63] Ships above 5,000 GT and that carry cargo or passengers, with at least one EEA port call in one Reporting Period from 2025.

Figure 11.4 Pooling of compliance



Source: Authors, based on ESSF SAPS WS1

All ships in the pool must register and validate their participation in the FuelEU database. This includes nominating a verifier for the pool (pool verifier) and allocating the compliance balance among the ships. Companies interested in pooling must register their intent in the FuelEU database, specifying the allocation of compliance and the chosen verifier. The pool verifier has the responsibility of verifying the allocation of compliance chosen by the companies, including the new compliance balance of each ship in the pool, after the allocation.

The verifier for the pool does not have to be the same as the verifier for the ship and its FuelEU report. However, all ships in a pool must have the same pool verifier.

There is no fixed deadline for registering, but the verifier must finalise and record the pool details by 30 April of the verification period. If, additionally, a ship will bank remaining surplus after participating in a pool, this will be handled by the ship's verifier and not the pool verifier. The issuance of a FuelEU DoC, if there are no penalties due, is also handled by the ship's verifier and not the pool verifier.

Ships that have a banked compliance surplus or have borrowed advance compliance in the previous year, but which have not made calls in EU/EEA calls in the subsequent year, are also allowed to participate in a pool. In these cases, despite not making port calls under the scope of the FuelEU Maritime Regulation, the ship can monetise its previous compliance surplus or compensate for its borrowed compliance, respectively, through participation in a pool.

11.4 FuelEU DoC

After complying with the requirements in the Regulation regarding the energy intensity targets and emissions at berth, and/or paying any penalties due, the ship can obtain a FuelEU DoC. The rules regarding the issuance of the FuelEU DoC are laid down in Article 22 of the Regulation.

The FuelEU DoC contains the following information:

- The identity of the ship (name, IMO identification number and port of registry or home port)
- Name, address, and principal place of business of the shipowner
- Identity of the verifier
- The date of issue of that document, its period of validity, and the reporting period it refers to

The Commission developed a standard template for the FuelEU DoC. The template is included in Annex IV of Commission Implementing Regulation (EU) 2024/2027.

The FuelEU DoC is, in principle, issued by the ship's verifier (Article 22(1)). This is the case if the ship does not have a compliance deficit, does not have non-compliant port calls, and complies with the obligation to hold a valid FuelEU DoC. The verifier will then include the FuelEU DoC in the FuelEU Database as soon as possible after the issuance.

The validity of the FuelEU DoC can be determined in two ways (Article 22(4)):

First, the DoC has a validity of 18 months after the end of the reporting period.

Validity example 1

The reporting period is 2025. The FuelEU DoC is issued no later than 30 June 2026. If the FuelEU DoC is issued for this reporting period, it will remain valid until 30 June 2027 (i.e. 18 months after the closing of the reporting period).

Second, the FuelEU DoC is valid until a new FuelEU DoC is issued. This could be the case for ships regularly visiting EU ports and therefore have subsequent reporting periods.

Validity example 2

The reporting period is 2025. The FuelEU DoC is issued no later than 30 June 2026. Similar to the example above, this FuelEU DoC is valid until 30 June 2027.

If the ship is also reporting for 2026, the FuelEU DoC for that period should be issued no later than 30 June 2027. However, if the reporting and subsequent verification are done quicker and, as a result, the FuelEU DoC is issued earlier (e.g. 30 May 2027), this FuelEU DoC will replace the earlier one.

If the ship is subject to payment of penalties, it is the competent authority of the administering State that will issue the FuelEU DoC after the penalties have been paid. This can be the case, for example, because after applying flexibility mechanisms, there is a remaining compliance deficit, or there were non-compliant port calls. More information on penalties can be found in Chapter 12. The FuelEU DoC is issued once the verification is completed and before or until the verification period has closed. This should be no later than 30 June of the year following the reporting period. The reporting period is defined as a period between 1 January and 31 December of a specific calendar year (Article 3(41)).

Example of a timeline for obtaining a FuelEU DoC

Ship monitoring is done between 1 January and 31 December 2025. This means that 2025 is the reporting period. The collected data need to be shared (in the form of a FuelEU report) with the verifier no later than 31 January 2026. The verifier needs to verify the data and approve the monitoring and reporting done by 31 March 2026 at the latest. After this date, any flexibility mechanisms can be applied and after a new compliance balance is calculated (if relevant). The compliance balance should be verified and uploaded by 30 June 2026.[64] This is also the final date that the FuelEU DoC can be issued.

Companies have the right to review the calculations and measures addressed to them by the verifier, including the refusal to issue a FuelEU DoC if that were the case (Article 26). The application for a review shall be lodged with the competent authority of the Member State in which the verifier is accredited, within one month of the notification from the verifier.

[64] It should be noted that the process for generating a DoC in THETIS is similar for both the FuelEU Maritime and the EU MRV.

12 Penalties and sanctions

The FuelEU Maritime Regulation includes the possibility of imposing **penalties and sanctions on non-compliant ships**. Both are imposed by Member State authorities. Penalties are imposed when a ship fails to meet a compliance balance of at least zero. Sanctions are imposed when a ship fails to present a valid FuelEU DoC during a port State control inspection. This chapter provides further detail on both penalties and sanctions.

Article 27 states that each Member State needs to appoint one or more competent authorities to enforce the Regulation. The Member States need to communicate the name(s) and contact information of the appointed authorities to the Commission. For an up-to-date list of authorities appointed, please refer to the Commission's website.

12.1 FuelEU penalties

Under certain conditions, a ship can be penalised under the FuelEU Maritime Regulation (Article 23). **A penalty needs to be paid when**:

- the ship has a compliance deficit and therefore does not meet the GHG intensity laid down in Article 4(2), either because
  - it does not make use of flexibility mechanisms to reach a compliance balance of at least zero or
  - still has a compliance deficit after pooling
- the ship did not meet the sub target for Renewable Fuels from Non-Biological Origin (RFNBO) as laid down in Article 5(3)
- the ship made at least one non-compliant port call from 2030 onwards in the light of Article 6 (i.e. non-compliance with the obligation to use OPS or zero-emissions technologies at berth)

The verifier will report no later than 30 May that the ship is non-compliant and therefore has to pay a penalty. The registration is made in the FuelEU database. Based on this registration, **the administering State will collect the penalty**. Once the penalty is paid, the ship still receives the FuelEU DoC. However, in this case, it is issued by the administering State instead of the verifier.

Calculating the penalty in case of a compliance deficit

In case the ship has a compliance deficit on GHG intensity, the FuelEU penalty is based on the difference between the amount and cost of fuel that the ship actually used and the amount and cost of fuel that the ship should have used to meet the requirements of the Regulation.

FuelEU penalty in case of a GHG intensity compliance deficit

The FuelEU penalty will be calculated as follows in case of a compliance deficit on GHG intensity, following Annex IV, Part B of the Regulation:

$$FuelEUpenalty\ [EUR] = \frac{|Verified\ compliance\ balance|}{GHGIE_{actual} \times\ 41{,}000 \frac{MJ}{tfuel}} \times 2{,}400 \frac{EUR}{tfuel}$$

The standard formula contains a set of fixed elements, meaning the following:

- The verified compliance balance is the absolute value of the compliance balance expressed in g CO_2eq
- $GHGIE_{actual}$ corresponds with the GHG intensity of the fuel used
- The 41,000 MJ is equivalent to 1 metric ton Very Low Sulphur Fuel Oil (VLFSO)
- The 2,400 is the amount to be paid in EUR per equivalent metric ton of VLSFO

Example of FuelEU penalty calculation in case of a GHG intensity compliance deficit

As an example, the following could be assumed. A ship has a compliance deficit of 1,221,220,000 g CO_2eq. The GHG intensity to apply equals 90.77 g CO_2eq/MJ. When applying the formula, the penalty would amount to EUR 787,551.

$$\frac{|1{,}221{,}220{,}000\ \mathrm{g\ CO2eq}|}{90.77\ \frac{\mathrm{g\ CO2eq}}{MJ} \times\ 41{,}000\ \frac{MJ}{tfuel}} \times 2{,}400\ \frac{EUR}{tfuel} = EUR\ 787{,}551$$

Calculating the penalty in case of not meeting the RFNBO sub-target

In case the ship does not meet the sub target for RFNBO, the FuelEU penalty is based on the amount of renewable and low-carbon fuels that the ship should have used to meet the requirements of the Regulation and the price difference between the RFNBO and fossil fuel.

FuelEU penalty in case of a compliance deficit on the RFNBO sub target

The FuelEU Penalty will be calculated as follows in case of a compliance deficit on the RFNBO sub-target, following Annex IV, Part B of the Regulation:

$$\frac{|CB\ RNFBO\ |}{41{,}000\ \frac{MJ}{tfuel}} \times Price\ difference\ RFNBO$$

The standard formula contains a set of fixed elements, meaning the following:

- The CB_{RNFBO} is the value of the compliance balance for RFNBO
- The 41,000 MJ is equivalent to 1 metric ton Very Low Sulphur Fuel Oil (VLFSO)
- The price difference is the price difference between RFNBO and fossil fuel

Calculating the penalty in case of non-compliant port calls

In case the ship makes a non-compliant port call from 2030 onwards, a penalty needs to be paid as well. A ship makes a non-compliant port call when it does not fulfil the requirements laid down in Article 6 (see Chapter 6). This penalty is not immediate but forms a part of the ship's overall compliance balance calculated during the verification period (discussed in Section 10.2). A penalty would need to be paid by 30 June of the verification period.

The level of the penalty is determined by the multiplication of the following three factors:

1. Rate of penalty fee: 1.5 Euro/kWh

2. Established total electric power demand of the ship at berth in kW (see Annex II of this guidance for how this value should be calculated and entered on a ship's FuelEU Monitoring Plan)
3. Number of non-compliant hours at berth (total number of hours rounded up to the nearest whole hour). Note: only port calls with less than 2 hours are fully excluded from the OPS requirement. Non-compliance in port call with 3 hours at berth, should oblige for a payment of a penalty equivalent to 3 hours

FuelEU penalty in case of non-compliant port calls

The following example presents the applicable penalty for a containership with an electrical power demand at berth of 2000 kW, which did not connect to OPS for 12 hours.

$$Penalty = 1.5\ EUR/kWh\ x\ 2{,}000\ kW\ x\ 12h\ =\ 36{,}000\ EUR$$

Increases to the FuelEU penalty

Under certain circumstances, it is possible to increase the original penalty given under the FuelEU Maritime Regulation. The Regulation identifies two circumstances under which the penalty can be multiplied:

1. **A ship receives penalties in consecutive periods:** If the ship has a compliance deficit for two consecutive reporting periods or more, the penalty can be increased.[65] In this case, the ship will incur an additional charge that increases by an additional 10% annually, as stated in Article 23(2) of the Regulation. The FuelEU penalty in this case can be adjusted as follows:

$$Total\ Penalty = FuelEU\ Penalty \times (1 + (n-1)\ \times\ 0.10).$$

In this formula, 'n' stands for the number of consecutive reporting periods for which a ship is subject to a FuelEU penalty.

As an example, if a ship has a compliance deficit for three consecutive reporting periods (n = 3), the calculation of the total penalty would include an additional charge of 20% in the verification following the third year.

$$(n-1)\ \times\ 0.10 = (3-1)\ \times\ 0.10 = 0.20$$

If the penalty calculated in the third year is €787,551, the total penalty would be:

$$Total\ Penalty = 787{,}551\ EUR\ \times\ (1 + 0.20)\ =\ 945{,}061\ EUR$$

2. **A ship borrows in advance but does not make any port calls in the consecutive year**. This could be the case if the ship has a compliance deficit in year 1 and decides to borrow from year 2, as it expects to have a compliance surplus in year 2. As highlighted in Section 11.2, the ship needs to ensure that this is indeed the case. It can happen that in

[65] The penalty does not increase in case the ship has a reporting period where it did not have any voyages in scope of the regulation, since such scenario does not fulfil the 'consecutive' condition. In addition, the penalty does not increase in case of shipping company changes.

year 2 the ship has no port calls in the EU/EEA during that year. As such, there is no reporting obligation. Nevertheless, the ship has not compensated for the compliance deficit from year 1. In this case, the ship may still compensate for its previous borrowing by joining a pool. Any remaining deficit (after joining a pool or if the ship does not join a pool) will result in a FuelEU penalty, which needs to be paid using the calculation as described above. In addition, the penalty calculated needs to be multiplied by 1.1. This serves as an additional penalty.

What happens when the penalty is paid?

Once the penalty has been paid, the ship will receive its FuelEU DoC from the administering State. The ship can operate in EU waters. For further details, please refer to Section 11.4.

12.2 Sanctions

By 30 June of the verification period, the FuelEU DoC should be held by the ship as evidence of compliance. Having a DoC on board will grant the ship access to all EU and EEA ports. During port State control inspections, the port State authority checks whether the ship indeed holds a valid DoC. **In case the ship does not have a valid DoC on board, the port State control inspector can issue a sanction.**

Member States should, based on Article 25(1), lay down sanctions applicable to infringements of the Regulation, e.g. not having a valid DoC on board the ship. The specific sanctions, the severity thereof and accompanying execution need to be set out in national law. Therefore, differences might occur from Member State to Member State. Nevertheless, the sanctions need to be effective, proportionate, and dissuasive.

In case a ship does not hold a valid FuelEU Doc, **Member States can opt for sanctions such as**:

- A warning, both verbal and in writing
- A fine
- Flag detention
- Restricted access to ports
- Expulsion from ports

It should be noted that the expulsion from ports is a severe sanction. The procedure for an expulsion order can start when a ship fails to comply with its obligation to carry a FuelEU DoC for two or more consecutive reporting periods. The competent authority that has issued the expulsion order will notify the following authorities, through the FuelEU database:

- European Commission
- the other EEA Member States and
- the flag State concerned

The consequence of the expulsion order is that every Member State should refuse entry to the ship concerned until that ship fulfils its obligations. The only exception to this rule applies to the Member State whose flag the ship is flying.

Part III – Closing remarks

13 Outlook

Throughout the document, reference has been made to possible deviating application of the Regulation, for instance, through temporary exemptions, and possible changes to the current legal text. This chapter provides a short summary of elements that might change given time or based on a review of the function of the Regulation, based on Article 30.

Temporary exemptions

The Regulation introduces several temporary exemptions. Below are the exemptions discussed in this document are presented again.

- As mentioned in Chapter 3, the Regulation allows for a temporary exemption of **certain voyages**, for instance, in the outermost regions. These exemptions will cease from 1 January 2030 onwards. From then on, the main rules, as laid down in Article 2(1), will apply to these voyages as well.

- As mentioned in Chapter 4, the Regulation does set targets for the **use of RFNBOs**. When ships meet the targets and the envisioned share of RFNBOs in the fuel mix is met, the requirements remain the same. If the Commission assessment shows that the targets are not met, stricter targets can be set, which will apply from 1 January 2034 onwards.

- As mentioned in Chapter 4, ships **sailing in ice conditions** can request to exclude the additional energy used for this activity be excluded from their compliance balance. Such an exemption can be requested until 31 December 2034. From 2035 onwards, ships could no longer request the exemption. However, the Regulation offers the possibility to review this clause (see next section).

- As mentioned in Chapter 6, the **obligation to use OPS** will be introduced gradually.[66] When a ship calls in a TEN-T port meeting the criteria of Article 6(1), from 1 January 2030 onwards, the ship needs to use OPS. In non-TEN-T ports, this obligation will enter into effect from 1 January 2035 onwards. It is important to note that the obligation only exists when the non-TEN-T port offers the possibility to connect to OPS. Nevertheless, the use of OPS will be more widespread from 2035 onwards.

Possible changes based on Article 30[67]

Article 30(2) obliges the EC to review the functioning of the Regulation no later than 31 December 2027. After that date, a similar exercise needs to be conducted every five years. Elements discussed in this document that need to be assessed relate to:

- Possible scope extension of the Regulation to **include more ship types** in the scope. A possible element for review is the extension to other ship types than cargo and passenger ships, for instance, offshore ships. It could also be possible to **change the minimum size** of the ships falling under the scope from 5,000GT to a size smaller than 5,000GT.

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66 EAFO maintains a list on available OPS infrastructure for maritime and inland waterways.

67 Please note that this list indicative. There is no obligation for the European Commission to amend the FuelEU Maritime Regulation.

- Possible extension of the validity for ships requesting to exclude the additional energy use due **to sailing in ice conditions**. Currently, this exemption is granted until 31 December 2034. Nevertheless, the review could assess to extend this period.

- Possible acceptance of new technologies, such as **Wind-Assisted Propulsion Systems (WASPs)**. The current reward factor is based on installed nominal power. Ideally, a reward would be based on the actual energy generated. To do so, a verifiable monitoring method should become available. Once this is in place, the inclusion of WASPS in the calculations could be changed.

- Possible acceptance of new technologies, such as technologies for **carbon capture storage**. Onboard carbon capture is currently not recognised under the FuelEU Maritime Regulation. However, the review will specifically consider the inclusion of carbon capture and other abatement technologies.

14 Further information

This guidance document is not a stand-alone document and also does not cover all elements. Therefore, an overview of other relevant sources is included here.

EC website

For general information on the FuelEU Maritime Regulation and the status of implementation, you are kindly referred to the Commission website. For the up-to-date legal text as well as the adopted secondary legislation, please refer to EUR-Lex. Regarding the Union Database for Biofuels, the Public Wiki may be consulted.

Questions and Answers

On the website of the EC, DG MOVE, a set of questions and answers is included. Based on an article-by-article basis, the most frequently asked questions are presented. This Q&A is regularly updated and renewed.

Relevant documents

Throughout this guidance document, other relevant documents have been mentioned. The following documents may be of interest:

1. The guidance documents on the implementation of the EU MRV and EU ETS system. Document no. 1 especially provides shipping companies with general insights.
2. The guidance document on biomass in the EU ETS provides further information on how to deal with RFNBO and RCF.
3. The guidance on accreditation and verification of the EU MRV and EU ETS system (Guidance Document no. 3).

Tutorials

To support you with the use of THETIS in general and the FuelEU Database module in particular, EMSA developed a series of tutorials which can be consulted for free. All tutorials can be found on the EMSA website.

Webinars

As part of the implementation of the FuelEU Maritime Regulation, the EC, together with EMSA, organised a series of webinars explaining specific elements of the Regulation. These webinars have been recorded and can be reviewed. All webinars can be found on the EMSA website.

Email addresses

To support you with any specific questions you may have, and which have not been answered by any of the available documents and tools, the EC created two dedicated email addresses.

- If you have any questions regarding the use of the FuelEU Database (THESTIS) or IT-related questions, please contact: maritimesupportservices@emsa.europa.eu.
- If you have any questions regarding the FuelEU Maritime Regulation in general, policy matters or regulatory aspects, please contact: fitfor55@emsa.europa.eu.

Annex I – Steps to determine WtW GHG intensity of fuels

This section describes the steps to determine the WtW GHG intensity of fossil fuels based on the default WtT and TtW emission factors provided in Annex II of the Regulation. Note that the steps for MDO/MGO and LNG consumed in a Diesel Dual Fuel Slow Speed engine have been addressed in Tables 4.2 and 4.3 in Section 4.3.1 of this guidance document.

Table AI.1 Steps to determine the WtW GHG intensity of LFO

Step	Value (gCO_2eq/MJ)	Notes on how to obtain the value
WtT (WtT) emissions	13.2	• This value can be found directly Annex II of the Regulation (see column 4). • For fossil fuels, the default WtW emission factors must always be applied.
TtW CO_2 emissions	76.85	• This value can be derived from Annex II of the Regulation by taking the emission factor (Cf) for CO_2 for the fuel (3.151 gCO_2 per gram of fuel, see column 6), divided by the LCV of the fuel (0.041 MJ/gram, see column 3);
TtW CH_4 emissions	0.03	• This value can be derived from Annex II of the Regulation by taking the CH_4 emission factor (C_f) for the fuel (0.00005 per gram fuel), divided by the LCV of the fuel (0.041 MJ/gram) • This calculated value (0.0012 g CH_4/MJ) must then be multiplied by 25, which is the Global Warming Potential of CH_4 over 100 years presently applied for FuelEU
TtW N_2O emissions	1.31	• This value can be derived from Annex II of the Regulation by taking the N_2O emission factor (C_f) for the fuel (0.00018 gCO_2 per gram of fuel, see column 8), divided by the LCV of the fuel (0.041 MJ/gram). • This calculated value (0.0044 g N_2O/MJ) must then be multiplied by 298, which is the Global Warming Potential of N_20 over 100 years presently applied for FuelEU
Adding the values of steps 1 (WtT) together with step 2-4 (TtW) gives a total WtW GHG intensity of 13.2 + 76.85 + 0.03 + 1.31 = 91.39 gCO_2eq/MJ		

Source: Authors, based Annex II of the FuelEU Maritime Regulation

Table AI.2 Steps to determine the WtW GHG intensity of LNG in an LNG Otto dual fuel medium speed engine

Step	Value (gCO_2eq/MJ)	Notes
WtT (WtT) emissions	18.5	• This value can be found directly Annex II of the Regulation (see column 4). • For fossil fuels the default WtW emission factors must always to be applied.
TtW CO_2 emissions including slippage	54.27	• CO_2 emissions are calculated for the mass of fuel excluding slippage, so you apply a factor (1-C_{slip}) • The C_{slip} value for LNG in this type of engine is 3.1% according to Annex II (1-3.1%) = 0.969 • This value is then multiplied by the emission factor (Cf) for CO_2 for the fuel (2,750 gCO_2 per gram of fuel, see column 6). • This calculated value is then divided by the LCV of the fuel (0.0491 MJ/gram);
TtW CH_4 emissions	15.78	• Annex II gives a value of 0 gCH_4 per gram of fuel, so only slipped emissions need to be calculated. • The value for CH_4 slippage for this engine type (.3.1% or .031 in this case) is multiplied by the global warming potential value for CH_4 used in FuelEU which is 25. • This calculated value is then divided by the LCV of the fuel (0.0491 MJ/gram)
TtW N_2O emissions	0.65	• N_2O emissions are calculated for the mass of fuel excluding slippage so you apply a factor (1-C_{slip}) • The C_{slip} value for LNG in this type of engine is 3.1% according to Annex II (1-3.1%) = 0.969 • This value is then multiplied by the emission factor (Cf) for N_2O for the fuel (.00011 g N_2O per gram of fuel, see column 6). The resulting value is then multiplied by the global warming potential for N_2O used for FuelEU (298) which results in 0.032. • This calculated value is then divided by the LCV of the fuel (0.0491 MJ/gram)
Adding the values of steps 1 (WtT) together with step 2-4 (TtW) gives a total WtW GHG intensity of 18.5 + 54.27 + 15.78 + 0.65 = 89.2 gCO_2eq/MJ		

Source: Authors, based on Annex II of the FuelEU Maritime Regulation

Table AI.3 Steps to determine the WtW GHG intensity of LNG in an LNG Otto dual fuel slow speed

Step	Value (gCO_2eq/MJ)	Notes
WtT (WtT) emissions	18.5	• This value can be found directly Annex II of the Regulation (see column 4). • For fossil fuels the default WtW emission factors must always to be applied.
TtW CO_2 emissions including slippage	55.06	• CO_2 emissions are calculated for the mass of fuel excluding slippage, so you apply a factor ($1-C_{slip}$) • The C_{slip} value for LNG in this type of engine is 1.7% according to Annex II (1-1.7%) = 0.983 • This value is then multiplied by the emission factor (Cf) for CO_2 for the fuel (2,750 gCO_2 per gram of fuel, see column 6). • This calculated value is then divided by the LCV of the fuel (0.0491 MJ/gram);
TtW CH_4 emissions	8.66	• Annex II gives a value of 0 gCH_4 per gram of fuel, so only slipped emissions need to be calculated. • The value for CH_4 slippage for this engine type (1.7% or .017 in this case) is multiplied by the global warming potential value for CH_4 used in FuelEU which is 25. • This calculated value is then divided by the LCV of the fuel (0.0491 MJ/gram)
TtW N_2O emissions	0.66	• N_2O emissions are calculated for the mass of fuel excluding slippage so you apply a factor ($1-C_{slip}$) • The C_{slip} value for LNG in this type of engine is 1.7% according to Annex II (1-1.7%) = 0.983 • This value is then multiplied by the emission factor (Cf) for N_2O for the fuel (.00011 g N_2O per gram of fuel, see column 6). The resulting value is then multiplied by the global warming potential for N_2O used for FuelEU (298) which results in 0.032. • This calculated value is then divided by the LCV of the fuel (0.0491 MJ/gram)
Adding the values of steps 1 (WtT) together with step 2-4 (TtW) gives a total WtW GHG intensity = 18.5 + 55.06 + 8.66 + 0.66 = 82.88 gCO_2eq/MJ		

Source: Authors, based on Annex II of the FuelEU Maritime Regulation

Table AI.4 Steps to determine the WtW GHG intensity of LNG in an LNG lean burn spark ignited engine (LBSI)

Step	Value (gCO_2eq/MJ)	Notes
WtT (WtT) emissions	18.5	• This value can be found directly Annex II of the Regulation (see column 4). • For fossil fuels the default WtW emission factors must always to be applied.
TtW CO_2 emissions including slippage	54.55	• CO_2 emissions are calculated for the mass of fuel excluding slippage, so you apply a factor (1-C_{slip}) • The C_{slip} value for LNG in this type of engine is 2.6% according to Annex II (1-2.6%) = 0.974 • This value is then multiplied by the emission factor (Cf) for CO_2 for the fuel (2,750 gCO_2 per gram of fuel, see column 6). • This calculated value is then divided by the LCV of the fuel (0.0491 MJ/gram);
TtW CH_4 emissions	13.24	• Annex II gives a value of 0 gCH_4 per gram of fuel, so only slipped emissions need to be calculated. • The value for CH_4 slippage for this engine type (2.6% or .026 in this case) is multiplied by the global warming potential value for CH_4 used in FuelEU which is 25. • This calculated value is then divided by the LCV of the fuel (0.0491 MJ/gram)
TtW N_2O emissions	0.65	• N_2O emissions are calculated for the mass of fuel excluding slippage so you apply a factor (1-C_{slip}) • The C_{slip} value for LNG in this type of engine is 2.6% according to Annex II (1-2.6%) = 0.974 • This value is then multiplied by the emission factor (Cf) for N_2O for the fuel (.00011 g N_2O per gram of fuel, see column 6). The resulting value is then multiplied by the global warming potential for N_2O used for FuelEU (298) which results in 0.032. • This calculated value is then divided by the LCV of the fuel (0.0491 MJ/gram)
Adding the values of steps 1 (WtT) together with step 2-4 (TtW) gives a total WtW GHG intensity of 18.5 + 54.55 + 13.24 + 0.65 = 86.94 gCO_2eq/MJ		

Source: Authors, based on Annex II of the FuelEU Maritime Regulation

Table AI.5 Steps to determine the WtW GHG intensity of LPG (Butane)

Step	Value (gCO_2eq/MJ)	Notes on how to obtain the value
WtT (WtT) emissions	7.8	• This value can be found directly Annex II of the Regulation (see column 4). • For fossil fuels the default WtW emission factors must always to be applied.
TtW CO_2 emissions	65.87	• This value can be derived from Annex II of the Regulation by taking the emission factor (Cf) for CO_2 for the fuel (3.030 gCO_2 per gram of fuel, see column 6), divided by the LCV of the fuel (0.046 MJ/gram, see column 3);
TtW CH_4 emissions	0.027	• This value can be derived from Annex II of the Regulation by taking the highest CH_4 emission factor (C_f) for the fuel class (0.00005 per gram fuel), divided by the LCV of the fuel (0.046 MJ/gram) • This calculated value (0.0011 g CH_4/MJ) must then be multiplied by 25, which is the Global Warming Potential of CH_4 over 100 years presently applied for FuelEU
TtW N_2O emissions	1.17	• This value can be derived from Annex II of the Regulation by taking the highest N_2O emission factor (C_f) for the fuel class (0.00018 gCO_2 per gram of fuel, see column 8), divided by the LCV of the fuel (0.046 MJ/gram). • This calculated value (0.0039 g N_2O/MJ) must then be multiplied by 298, which is the Global Warming Potential of N_20 over 100 years presently applied for FuelEU
Adding the values of steps 1 (WtT) together with step 2-4 (TtW) gives a total WtW GHG intensity of 7.8 + 65.87 + 0.027 + 1.17 = 74.86 gCO_2eq/MJ		

Source: Authors, based on Annex II of the FuelEU Maritime Regulation

Table AI.6 Steps to determine the WtW GHG intensity of fossil Hydrogen (H_2), Natural Gas fuel cells

Step	Value (gCO_2eq/MJ)	Notes on how to obtain the value
WtT (WtT) emissions	132	• This factor can be found in Annex II of the Regulation (see column 4) • For fossil fuels the default emission factors as given in the Regulation have to be applied.
TtW CO_2 emissions	0	• This can be derived from Annex II of the Regulation by taking the emission factor (Cf) for CO_2 for the fuel (0 gCO_2 per gram of fuel), divided by the LCV of the fuel (0.12 MJ/gram);
TtW CH_4 emissions	0	• This can be derived in Annex II of the Regulation by taking the CH_4 emission factor for the fuel (0.0 per gram fuel), divided by the LCV of the fuel (0.12 MJ/gram). • This value must then be multiplied by 25, which is the Global Warming Potential of CH_4 over 100 years presently applied for FuelEU
TtW N_2O emissions	0	• This can be derived in Annex II of the Regulation by taking the N_2O emission factor (C_f) for the fuel (0 gCO_2 per gram of fuel), divided by the LCV of the fuel (0.12 MJ/gram). • This value must then be multiplied by 298, which is the Global Warming Potential of N20 over 100 years presently applied for FuelEU
Adding the values of steps 1 (WtT) together with step 2-4 (TtW) gives a total WtW GHG intensity of 132 gCO_2eq/MJ		

Source: Authors based Annex II of the FuelEU Maritime Regulation

Table AI.7 Steps to determine the WtW GHG intensity of fossil Hydrogen (H2) Natural Gas used in an Internal Combustion Engine

Step	Value (gCO_2eq/MJ)	Notes on how to obtain the value
WtT (WtT) emissions	132	• This factor can be found in Annex II of the Regulation (see column 4) • For fossil fuels the default emission factors as given in the Regulation have to be applied.
TtW CO_2 emissions	0	• This can be derived from Annex II of the Regulation by taking the emission factor (C_f) for CO_2 for the fuel (0 gCO_2 per gram of fuel), divided by the LCV of the fuel (0.12 MJ/gram);
TtW CH_4 emissions	0.0	• This can be derived in Annex II of the Regulation by taking the CH_4 emission factor for the fuels (0.0 per gram fuel), divided by the LCV of the fuel (0.12 MJ/gram). • This value must then be multiplied by 25, which is the Global Warming Potential of CH_4 over 100 years presently applied for FuelEU
TtW N_2O emissions	0.45	• This value can be derived from Annex II of the Regulation by taking the highest N_2O emission factor (C_f) for the fuel class since the Annex reads 'TBM' (.00018 gCO_2 per gram of fuel), divided by the LCV of the fuel (0.12 MJ/gram). • This value must then be multiplied by 298, which is the Global Warming Potential of N20 over 100 years presently applied for FuelEU. • Note that column 8 of Annex II gives the N_20 emission factor as TBM. Pending an actual value, the highest emission factor for the fuel class it to be used
Adding the values of steps 1 (WtT) together with step 2-4 (TtW) gives a total WtW GHG intensity = 132.45 gCO_2eq/MJ		

Source: Authors based Annex II of the FuelEU Maritime Regulation

Table AI.8 Steps to determine the WtW GHG intensity of fossil Ammonia (NH3) when used in Fuel cells and with an Internal Combustion Engine

Step	Value (gCO_2eq/MJ)	Notes on how to obtain the value
WtT (WtT) emissions	121	• This value can be found in Annex II of the Regulation (see column 4) • For fossil fuels the default emission factors as given in the Regulation have to be applied.
TtW CO_2 emissions	0	• This value can be derived from Annex II of the Regulation by taking the emission factor (C_f) for CO_2 for the fuel (0 gCO_2 per gram of fuel), divided by the LCV of the fuel (0.0186 MJ/gram);
TtW CH_4 emissions	0.067	• This value can be derived from Annex II of the Regulation by taking the highest CH_4 emission factor (C_f) for the fuel class (0.00005 per gram fuel), divided by the LCV of the fuel (0.0186 MJ/gram) • This calculated value (0.00268 g CH_4/MJ) must then be multiplied by 25, which is the Global Warming Potential of CH_4 over 100 years presently applied for FuelEU
TtW N_2O emissions	2.88	• This can be derived in Annex II of the Regulation by taking the highest N_2O emission factor (Cf) for the fuel class since column 8 reads 'TBM' (.00018 gCO_2 per gram of fuel), divided by the LCV of the fuel (0.0186). • This value must then be multiplied by 298, which is the Global Warming Potential of N_20 over 100 years presently applied for FuelEU. • Note that column 8 of Annex II gives the N_20 emission factor as TBM. Pending an actual value, the highest emission factor for the fuel class it to be used
Adding the values of steps 1 (WtT) together with step 2-4 (TtW) gives a total WtW GHG intensity = 121 + 0.067 + 2.88 = 123.95 gCO_2eq/MJ		

Source: Authors, based Annex II of the FuelEU Maritime Regulation

Table AI.9 Steps to determine the WtW GHG intensity of fossil methanol.

Step	Value (gCO_2eq/MJ)	Notes on how to obtain the value
WtT (WtT) emissions	31.3	• This value can be found directly in Annex II of the Regulation (see column 4) • For fossil fuels the default emission factors as given in the Regulation have to be applied.
TtW CO_2 emissions	69.1	• This value can be derived from Annex II of the Regulation by taking the emission factor (Cf) for CO_2 for the fuel (1.375 gCO_2 per gram of fuel, see column 6), divided by the LCV of the fuel (0.0199 MJ/gram, see column 3);
TtW CH_4 emissions	0.063	• This value can be derived in Annex II of the Regulation by taking the highest CH4 emission factor for the fuel class (0.00005 per gram fuel), divided by the LCV of the fuel (0.0199 MJ/gramme). • This calculated value must then be multiplied by 25, which is the Global Warming Potential of CH4 over 100 years presently applied for FuelEU. • Note that column 8 of Annex II gives the N20 emission factor as TBM. Pending an actual value, the highest emission factor for the fuel class it to be used
TtW N_2O emissions	2.7	• This value can be derived from Annex II of the Regulation by taking the N_2O emission factor (C_f) for the fuel class since column 8 states 'TBM' (0.00018 gCO_2 per gram of fuel), divided by the LCV of the fuel (0.0199 MJ/gram). • This calculated value (0.009 g N_2O/MJ) must then be multiplied by 298, which is the Global Warming Potential of N_20 over 100 years presently applied for FuelEU
Adding the values of steps 1 (WtT) together with step 2-4 (TtW) gives a total WtW GHG intensity of 31.3 + 69.1 + 0.06 + 2.7 = 103.2 gCO_2eq/MJ		

Source: Authors, based on Annex II of the FuelEU Maritime Regulation

Annex II - Guidance on the Monitoring Plan's FuelEU parameters

Monitoring requirements for the FuelEU Maritime Regulation build on parameters shipping companies are already required to monitor under the EU MRV Regulation. For example, the mass of fuel a ship has consumed that is monitored under the EU MRV does not need to be monitored again for the FuelEU Maritime Regulation because the monitoring methods are the same. **This Annex therefore focuses only on the monitoring parameters that are different or new for the FuelEU Maritime Regulation.** For guidance on existing monitoring requirements of the EU MRV, shipping companies can consult the guidance documents on the implementation of the EU MRV and EU ETS system, specifically Chapter 4 of document no. 1 – General guidance for shipping companies: the EU ETS and MRV Maritime.

Table AII.1 below describes the additional Monitoring Plan parameters/datapoints that a shipping company is required to monitor under the FuelEU Maritime Regulation compared to under the EU MRV.[68] The code referred to (e.g. B.9) is the code of the relevant table given in the template for the FuelEU monitoring plan. As shown in Table AII.1 for ships that do not intend to use any alternative energy sources or perform voyages eligible for exemptions (such as through ice), only 4 tables will need to be added to create the ship's FuelEU Monitoring Plan from what should already be in place for the EU MRV.

Table AII.1 Supplementary FuelEU Monitoring Plan parameters/datapoints, compared to MRV

Monitoring requirement – required for all ships
1. B.9: Procedures for monitoring and reporting the WtT and TtW emission factors of energy to be used on board.
2. C.3.4: Procedures for determining and recording the time spent at sea and at berth.
3. D.5: Methods to be used to treat data gaps regarding time spent at sea and time spent at berth (quayside and anchorage.
4. E.5: Procedure for company internal review and validation of relevant data.
Monitoring requirement – only required for ships intending to use OPS/ZET or WAPS
1. B.4: Technical description of equipment to allow connection to OPS.
2. B.5: Description of Zero Emission Technology (including OPS).
3. B.6: Established total electrical power demand of the ship at berth.
4. B.7: Description of Wind Assisted Propulsion systems (WAPS).
5. B.8: Procedures to update and maintain the list of fuel consumers, OPS equipment, ZET and WAPS.
6. C.1.6: Procedures for monitoring energy provided by OPS (OPS).
7. C.1.7: Procedures for monitoring energy provided by a ZET.
8. D.7: Methods to be used to estimate energy consumption from OPS and ZET.
Monitoring requirement – only required for ships intending to use exceptions related to ice class
1. B.1: Identification of the ship's ice class.

[68] Note that there are also parts of an EU MRV Monitoring Plan that are not relevant for the FuelEU Maritime Regulation which do not need to be carried over (such as provisions on determining cargo carried).

Monitoring requirement – only required for ships intending to use exceptions related to ice class
2. C.1.8: Procedures for monitoring fuel consumption of each Fuel consumer when sailing in ice conditions.
3. D.4: Methods to be used to treat data gaps regarding the date, time and position when entering and leaving the ice conditions, the distance travelled when sailing in ice conditions.

Source: Authors, based on comparison of FuelEU and MRV monitoring plans

In the following sections, an explanation is given for each of the new monitoring plan tables, including a description of the content that is expected to be included. The full details of a ship-specific monitoring plan will depend highly on the type of ship and its installed energy consumers, and all content is subject to the approval of the ship's verifier.

The monitoring plan tables are discussed in the order that they appear in the FuelEU Monitoring Plan template.

B.1: Identification of ship and shipowner details

Table B.1 of a FuelEU Monitoring Plan is identical to Table B.1 for an MRV Monitoring Plan. However, if a shipping company intends to make use of any exemptions under FuelEU based on the ship's ice class, it is mandatory to fill in the field 'ice class.'

The ship's ice class (where applicable) should be expressed in terms of the ice class of the Finnish Swedish Ice Class Rules (Baltic Ice Classes), meaning IA Super, IA, IB or IC.[69] HELCOM Recommendation 25/7 describes how these classes correspond to different ice classes, which may be part of a ship's classification society notation. The information from HELCOM is reproduced in Table AII.2. Note that this is an approximation and the names of class notations may change, so companies should always check with their class society and FuelEU verifier to ensure the correct ice class is reflected in the Monitoring Plan.

To take an example: a ship with ice class notation 'Ice Class 1AS FS' from Lloyds Register should select 'IA Super' from the drop-down menu when preparing its FuelEU Monitoring Plan in THETIS MRV.

Table AII.2 Approximate correspondence between Ice Classes of the Finnish-Swedish Ice Class Rules (Baltic Ice Classes) and the Ice Classes of classification societies

Classification Society	Ice Class			
Finnish Swedish Ice Class Rules	IA Super	IA	IB	IC
Russian Maritime Register of Shipping (Rules 1995)	UL	L1	L2	L3
Russian Maritime Register of Shipping (Rules 1999)	LU5	LU4	LU3	LU2

[69] Implementing Regulation 2024/2031 also permits a ship's ice class to be indicated as one of the Polar Classes PC1-PC7. The polar classes PC1 to PC5 are above the IA super and are eligible for both ice derogations.

Classification Society	Ice Class			
Russian Maritime Register of Shipping (Rules 2008)	Arc 5	Arc 4	Ice 3	Ice 2
American Bureau of Shipping	Ice Class I AA	Ice Class I A	Ice Class I B	Ice Class I C
Bureau Veritas	ICE CLASS IA SUPER	ICE CLASS IA	ICE CLASS IB	ICE CLASS IC
CASPPR, 1972	A	B	C	D
China Classification Society	Ice Class B1*	Ice Class B1	Ice Class B2	Ice Class B3
Det Norske Veritas	ICE-1A*	ICE-1A	ICE-1B	ICE-1C
DNV GL	Ice(1A*)	Ice(1A)	Ice(1B)	Ice(1C)
Germanischer Lloyd	E4	E3	E2	E1
IACS Polar Rules	PC6	PC7	-	-
Korean Register of Shipping	IA Super	IA	IB	IC
Lloyd's Register of Shipping	Ice Class 1AS FS (+) Ice Class 1AS FS	Ice Class 1A FS (+) Ice Class 1A FS	Ice Class 1B FS (+) Ice Class 1B FS	Ice Class 1C FS (+) Ice Class 1C FS
Nippon Kaiji Kyokai	NS* (Class IA Super Ice Strengthening) NS (Class IA Super Ice Strengthening)	NS* (Class IA Ice Strengthening) NS (Class IA Ice Strengthening)	NS* (Class IB Ice Strengthening) NS (Class IB Ice Strengthening)	NS* (Class IC Ice Strengthening) NS (Class IC Ice Strengthening)
Polski Rejestr Statków	L1A	L1	L2	L3
Registro Italiano Navale	ICE CLASS IA SUPER	ICE CLASS IA	ICE CLASS IB	ICE CLASS IC

Source: HELCOM Recommendation 25/7

Table B.4: Technical description of equipment to allow connection to OPS

Table B.4 is specific to the FuelEU monitoring plan because OPS is not currently monitored under the MRV.

This table is only mandatory for containerships and passenger ships (which are required to connect to OPS in certain ports from 2030 onwards). However, in case other ship types also intend to use OPS, then this table should also be completed in the ship's FuelEU monitoring plan.

Table AII.3 Example Table B.4

OPS equipment reference no.	OPS equipment (name, type)	Technical description of OPS equipment specified voltage and frequency, including the gear specified in IEC/IEEE 80005 (High Voltage) and IEC/IEEE 80005-3 (Low Voltage) and position onboard	Standards
	(brand and model name)	• Shore connection nominal voltage: xxx • Shore connection earthing system: xxx • Number of cables to feed the ship: 1 • Location of the cable management system: berth	IEC/IEEE 80005

Source of example: EMSA SSE Guidance to Port Authorities and Administrations

Table B.5: Description of Zero Emission Technology

Table B.5 is specific to the FuelEU monitoring plan because the use of ZETs is not currently monitored under the MRV.

This table is only mandatory for containerships and passenger ships which do not use onshore power supply (and therefore will need to use another form of technology resulting in zero emissions at berth in order to comply with Article 6 of the Regulation).

Companies should note the type of ZET they will use and a general description. Commission Implementing Regulation 2024/2031 also requires that the rated power of the ZET is stated (see column 3).
Note: a reference to the certification of the ZET should also be given in the Monitoring Plan, following adoption of the relevant implementing act (see Section 6.2). This means a reference to the standard the ZET is certified to, the certifying body and the validity period of the certification.

At present, the list of eligible ZETs is as follows (as per Annex III for FuelEU):

1. Fuel cells
2. On-board electrical energy storage
3. On-board power generation from wind and solar energy

Table AII.4 Example Table B.5

ZET reference no.	ZET (name, type)	Technical description of ZET
	On-board electrical energy storage	Batteries are charged onboard by running the auxiliary engine at sea at medium load or, in some port calls, at the shore side. Rated power of battery: 2,500 kW

Source: Authors, based on the FuelEU Maritime Regulation

Table B.6: Established total electrical power demand of the ship at berth

Table B.6 is only mandatory for containerships and passenger ships (which are required to connect to OPS in certain ports from 2030 onwards). However, in case other ship types also intend to use OPS, then this table should also be completed on the ship's FuelEU monitoring plan.

The total electrical power demand represents a fixed value which can be derived in two possible ways:

1. The ship's electrical load balance or electrical load study used to demonstrate compliance with SOLAS Chapter II-1 Regulations 40 and 41, approved by its flag administration or Recognised Organisation.
2. In the absence of the above, the value should be indicated as 25 % of the total of the maximum continuous ratings of the main engines of the ship as specified in their International Air Pollution Certificate E(IAPP) certificate or,[70] if the engines are not required to have an EIAPP certificate, the nameplate of the engines.

Table AII.5 Example Table B.6

Established total electrical power demand of the ship at berth (kW)	Data Source
4925	25% of the MCR of the main engine as per Engine IAPP

Table B.7 Description of WAPSs (WAPS)

Table B.7 only needs to be completed when ships have WAPS installed and intend to make use of the reward factor under FuelEU for the ship's annual GHG intensity. One of the following options should be selected for the type of WAPS:

- rotor sails
- kites
- hard or rigid sails
- soft sails, suction wings, turbines
- other WAPS

The values Pwind and Pprop should be consistent with information within this ship's EEDI/EEXI technical file (see Section 4.5)

Table AII.6 Example Table B.7

WAPS reference no.	WAPS (name, type)	WAPS installation date	Technical description of WAPS	Pwind	Pprop
	1 x rotor sail	2023	Rotor sail installed mid-ship port side	1000 kW	19780 kW

Source: Authors, based on the FuelEU Maritime Regulation

Table B.8 Procedures, systems and responsibilities used to update the completeness of the list of fuel consumers, OPS equipment, ZET and WAPS

This table is very similar to B.7. under the EU MRV (which concerns procedures, systems and responsibilities used to update the completeness of emission sources). As such, companies should consult the guidance documents on the implementation of the EU MRV and EU ETS system (specifically page 70 of Guidance document no. 1 – General guidance for shipping companies: the EU ETS and MRV Maritime) for an example procedure, keeping in mind that for FuelEU, a wider range of ship systems may be subject to monitoring.

[70] An Engine International Air Pollution Prevention (EIAPP) certificate is required under MARPOL Annex VI, pertaining to the Nox Tier Code for engines.

A wider range of ship systems in scope for FuelEU potentially means more departments within the shipping company or ship (for instance, electricians or Electro-Technical Officers onboard in the case of OPS connections) may need to be engaged to ensure the monitoring plan is kept up to date. Company procedures should be established to ensure that the FuelEU Monitoring Plan is kept up to date.

Table B.9. Procedures for monitoring and reporting the WtT and TtW emission factors of energy to be used on board

Table B.9 is mandatory for the FuelEU Monitoring Plan (Article 8(3)(h) because the Regulation specifically includes the GHG emissions for fuels on a Well-to-Tank basis, whereas for the MRV the scope is, in general, only Tank to Wake emissions.

That being said, the MRV Regulation does allow for certain biofuels to be 'zero rated' depending on their production pathway and GHG reductions – a procedure for which should be included under Table B.9 of the ship's MRV plan.

As indicated throughout this document, where renewable and low-carbon fuels are used, the sustainability and GHG savings criteria need to be demonstrated in order to achieve emission reduction benefits under FuelEU. In contrast to fossil fuels, shipping companies will need to rely on documentation beyond a standard BDN for fuel. Procedures to gather and process these documents may involve a wide range of colleagues and departments across the shipping company. As such, companies should ensure that procedures used for MRV are still fit for purpose under FuelEU.

C.1.6: Procedures for monitoring energy provided by OPS (OPS)

Table C.1.6 is new in the FuelEU Monitoring Plan because OPS is not part of MRV monitoring.

The procedure described in this table should be consistent with the requirements of FuelEU Annex I, which requires ships to obtain an 'Electricity Delivery Note' (see Section 6.1.4).

C.1.7: Procedures for monitoring energy provided by a ZET

Detailed criteria for acceptance, including the definition of system boundaries and certification requirements of ZETs, are still to be developed. Guidance on procedures for monitoring energy provided by ZETs will be provided in a later version of this guidance document.

Table AII.7 Example Table C.1.7

Title of procedure	Monitoring energy provided by a ZET
Reference to the existing procedure	
Version of the existing procedure	
Description of procedure (a brief description of the procedure can be provided if already existing outside the monitoring plan)	
Name of person or position responsible for this procedure	
Location where records are kept	
Name of IT system used (where applicable)	

Source: Commission Implementing Regulation (EU) 2024/2031

C.1.8 Procedures for monitoring fuel consumption of each Fuel consumer when sailing in ice conditions

Table C.1.8 is mandatory if the company intends to make use of a derogation to exclude additional energy used due to sailing in ice conditions from the calculation of the compliance balance set out in Annex IV of Regulation (EU) 2023/1805.

Although Table C.1.8 is specific to FuelEU, companies will already have established procedures in place for monitoring fuel consumption under the MRV. These procedures will be detailed in Table C.2.1 of the ship's MRV monitoring plan.

For this Table C.1.8 specifically, shipping companies need to demonstrate how they will monitor fuel consumption when operating in ice conditions. The ship's specific fuel consumption in ice conditions is important for determining the potential deduction in energy used that ships may be eligible for.

Table C.3.4: Procedures for determining and recording the time spent at sea and at berth

The procedures described in Table C.3.4 are partially new for the FuelEU Maritime Regulation but are expected to be similar to those the company has already established for Table C.6 of the MRV Monitoring Plan (which concerns only time spent at sea).

However, for FuelEU, it is also important that companies have procedures in place to accurately monitor the ship's time spent at berth. This is because the FuelEU report has a field requiring the company to provide the ship's total time spent at berth in the reporting period (Part D.b of the FuelEU report). This is not required in the Emission Report; companies must file for the MRV. The reason is that for FuelEU, time spent at berth is important to determine (among other things) the applicability for exemptions for OPS/ZET or penalties due for container and passenger ships. As an example:

Table AII.8 Procedures for determining and recording the time spent at sea and at berth

Title of procedure	Determining and recording the time spent at sea from berth of the port of departure to berth of the port of arrival, and time spent at berth (quayside and anchorage)
Reference to the existing procedure	
Version of the existing procedure	
Description of procedures (including recording and managing port departure and arrival information) (a brief description of the procedure can be provided if already existing outside the monitoring plan)	The Master reports the time as per the GPS indications (or the Master Clock(s) / local time zone or GMT) in the Deck Logbook and in the Daily Noon Reports, Arrival and Departure time within port limits and at-berth are recorded separately. Time spent at sea is calculated at the end of each voyage and recorded in the voyage documents.
Name of person or position responsible for this procedure	Master / First Officer
Formulae and data sources	
Location where records are kept	Bridge, Noon reports
Name of IT system used (where applicable)	AMOS

Source: Authors based on The guidance documents on the implementation of the EU MRV and EU ETS system, specifically Section 7.3 of document no. 1 – General guidance for shipping companies: the EU ETS and MRV Maritime

Table D2: Methods to be used to estimate energy consumption from OPS and ZET (where applicable)

Table D.2 concerns procedures for handling potential data gaps when monitoring energy consumption from OPS and ZET.

In the first place, the risk of the occurrence of data gaps should be minimised by developing an appropriate monitoring plan. The guidance documents on the implementation of the EU MRV and EU ETS system provide information on a risk assessment that companies could perform to identify and set up systems to avoid data gaps. Section 6.2 of document no. 1 – General guidance for shipping companies: the EU ETS and MRV Maritime, especially. However, it is not possible to completely exclude events that require the closure of a data gap.

In cases where shipping companies cannot rely on their standard procedure to monitoring energy consumption from OPS or ZETs (Tables C.1.6 and C.1.7) consideration could be given towards estimating the ship's energy consumption based on the value provided in Table B.6 (total electrical power demand of the ship at berth) and the number of hours the ship spent at berth (supported by logbook entries or AIS).

D4: Methods to be used to treat data gaps regarding the date, time and position when entering and leaving the ice conditions, the distance travelled when sailing in ice conditions and D5: Methods to be used to treat data gaps regarding the date, time and position when entering and leaving the ice conditions, the distance travelled when sailing in ice conditions

Tables D.4 and D.5 are specific to FuelEU Monitoring Plans insofar as they treat data gaps for voyages through ice. However, companies will already have procedures in place for treating data gaps regarding distance travelled under the MRV (as per Table D.2 of that plan) and time spent at sea (as per Table D.4 of that plan).

Companies should assess how fit for purpose their procedures under the MRV are for treating data gaps for voyages in ice conditions. It is expected that data gaps can be covered via the use of, among other things:

- Table E.5: Ship logbooks
- AIS

Control activities: Internal reviews and validation of relevant data

Companies should refer to the guidance documents on the implementation of the EU MRV and EU ETS system, and specifically on p. 80 of Guidance document no. 1 – General guidance for shipping companies: the EU ETS and MRV Maritime. In general, the importance of companies having an internal procedure in place to ensure the correctness of monitored data before its submission to the verifier is valid for both Regulations.

However, since the scope of FuelEU is different to the MRV, companies should consider a broader spectrum of control activities to ensure the quality of monitored and reported data specific to FuelEU. Consideration could be given to, for instance:

- The completeness of PoS/PoC documentation for fuels consumed (e.g. E and LCV values, production pathway of fuel, etc).
- The correct assignment of emission factors, including engine Cslip where applicable.
- In cases where companies choose to deviate from default values (when possible), ensure evidence is provided in line with defined international standards.

Annex III – Bibliography

This Annex contains an overview of relevant literature, legislation, policy documents, and other materials that will be part of the guidance document.

EU legislation

- OJEU. (2007). Regulation (EC) No 765/2008 of the European Parliament and of the Council of 9 July 2008 setting out the requirements for accreditation and market surveillance relating to the marketing of products and repealing Regulation (EEC) No 339/93. 9/7/2008: No L 218. EUR-Lex
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- OJEU. (2009). Directive 2009/21/EC of the European Parliament and of the Council of 23 April 2009 on compliance with flag State requirements. 28/05/2009: No L 131/132. EUR-Lex
- OJEU. (2015). Regulation (EU) 2015/757 of the European Parliament and of the Council of 29 April 2015 on the monitoring, reporting and verification of carbon dioxide emissions from maritime transport, and amending Directive 2009/16/EC. EUR-Lex
- OJEU. (2018). Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources (recast). 21/12/2018: No L 328/82. EUR-Lex
- OJEU. (2020). Commission Delegated Regulation (EU) 2020/1044 of 8 May 2020 supplementing Regulation (EU) 2018/1999 of the European Parliament and of the Council with regard to values for global warming potentials and the inventory guidelines and with regard to the Union inventory system and repealing Commission Delegated Regulation (EU) No 666/2014. 8/05/2020: No L 230. EUR-Lex
- OJEU. (2023). Commission Delegated Regulation (EU) 2023/1185 of 10 February 2023 supplementing Directive (EU) 2018/2001 by establishing a minimum threshold for GHG emissions savings of RCF and by specifying a methodology for assessing GHG emissions savings from renewable liquid and gaseous transport fuels of non-biological origin and from RCF. 20/06/2023: No L 157/11. EUR-Lex
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- OJEU. (2024). Directive (EU) 2024/1788 of the European Parliament and of the Council of 13 June 2024 on common rules for the internal markets for renewable gas, natural gas, and hydrogen, amending Directive (EU) 2023/1791 and repealing Directive 2009/73/EC (recast). 13/06/2024: No L 2024/1788. EUR-Lex

- OJEU. (2024). Commission Implementing Regulation (EU) 2024/2027 of 26 July 2024 on verification activities pursuant to Regulation (EU) 2023/1805 and amending Directive 2009/16/EC. 26/07/2024: No L 2024/2027. EUR-Lex
- OJEU. (2024). Commission Implementing Regulation (EU) 2024/2031 of 26 July 2024 on the template for monitoring plans pursuant to Regulation (EU) 2023/1805 of the European Parliament and of the Council on the use of renewable and low-carbon fuels in maritime transport, and amending Directive 2009/16/EC. 26/07/2024: No L 2024/2031. EUR-Lex

Guidance documents

- HELCOM. (2004). *Safety of winter navigation in the Baltic Sea area.* Link
- European Commission. (2016). *Standard template for monitoring plans.* Link
- European Commission. (2022). *Guidance on biomass in the EU ETS.* Link
- EMSA (2022). Guidelines for shore-side electricity for port authorities and administrations. Link
- European Commission. (2023). *General guidance for shipping companies: the EU ETS and MRV Maritime (Guidance Document no. 1).* Link
- European Commission. (2024). *General guidance on accreditation and verification (Guidance Document no. 3).* Link
- ISCC System. (2024). *ISCC-Guidance-Document-Proof-of-Compliance-V1.0.* Link
- EMSA. (2024). *Tutorials on the EU ETS and FuelEU Maritime.* Link
- European Commission. (2025). *Voluntary schemes.* Link

Reports and studies

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- European Commission. (2025). *ESSF WS2 – Report on Marine Fuels Certification Procedures to support implementation of FuelEU Maritime.* Link

Websites and Online resources

- European Commission. (2023). *FuelEU Maritime overview.* Link
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- European Accreditation. (2024). *Directory of EA Members and MLA signatories.* Link
- European Sustainable Shipping Forum (2024). Sustainable Alternative Power for Shipping (ESSF-SAPS) Link
- Legal provisions of COM(2021)551 (2024) – Amendment of 2003/87/EC and 2015/1814.Link